Standard Size, 9 x 12. APRIL 20, 1899. Price Six Cents.

LIBRARY OF CONGRESS RECEIVED APR 22 1899 PERIODICAL DEPT.

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.
ISSUED WEEKLY BY THE AMERICAN MACHINIST PRESS,
Vol. 22. 218 WILLIAM STREET, NEW YORK. No. 16.

Contents and Index to Advertisers, Page 10.

The Flat Turret Lathe Is Not Perfect In Every Detail---It May Never Be.

But compared with any other turret machine it seems to be all that man can ask for. Every detail of its construction has been carefully watched and brought as near perfection as possible. Every tool used in its equipment has been the subject of studious consideration and development.

No finite mind can design a perfect machine; no machine shop on earth can make one at any marketable price.

Every new machine is a bundle of errors. Every other turret machine on the market requires something new about it to adapt it to your work. It takes time and money to keep such a machine supplied with the necessary special tools and in working order.

You can't afford to make a mistake in selecting a machine tool. There is something more than the price at stake. You must remember that the best business can be wrecked by using machinery that is not the best. The best machinery can only be obtained from specialists.

We make one thing, only one size of that thing, and nothing else. If in doubt give us a hearing. We are Specialists.

We have built Over One Thousand 2 x 24 Flat Turret Lathes. Each machine is a complete machine shop in itself for all lathe work under 2 in. in diameter and less than 24 in. long, and many forgings of larger diameter.

FOR SALE ONLY BY

JONES & LAMSON MACHINE COMPANY,

SPRINGFIELD, VERMONT, U. S. A., and

English Offices—Jones & Lamson Machine Co., Exchange Buildings, Stephenson's Place, Birmingham; Henry Kelley & Co., No. 25 Pall Mall, Manchester. Office for Germany, Holland, Belgium, Switzerland, Austria-Hungary, and Italy—M. Koyemann, Charlottenstrasse 112, Düsseldorf, Germany. France—Ph. Bonvillain, 6, Rue Blanche, 6, Paris.

Grinding and Polishing Machinery.

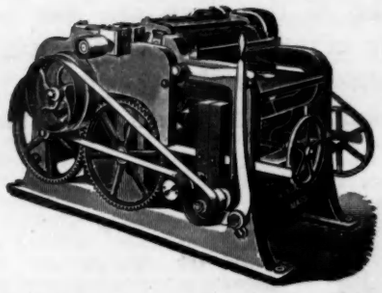
POINTS WHICH APPEAL TO BUYERS :

New Designs.
Large Spindles.
Self-Oiling Bearings,
The Best Materials.

Accurate and Careful Machine Work and Construction.

For sale by the trade generally, and by Charles Churchill & Co., Ltd., London, England; Fenwick Freres & Co., Paris, France, and Schuchardt & Schütte, Berlin, Germany.

BUILDERS IRON FOUNDRY,
PROVIDENCE, R. I., U. S. A.



This is the Planer

that Whitney makes—the P-4 Planer—the Planer that planes stuff less than three inches long without clipping the ends, and the Planer that's doing the particular planing in some of the biggest and best wood-working shops in the world. The Whitney Book goes into details, and it's free.

Baxter D. Whitney,
WINCHENDON,
MASS.

HYDRAULIC PRESSES
AND HYDRAULIC MACHINERY,
BUILT BY THE
BRANDYWINE MACHINE WORKS
WILMINGTON, DEL.

20"
21"
25"
28"
30"
36"

UPRIGHT DRILLING MACHINES

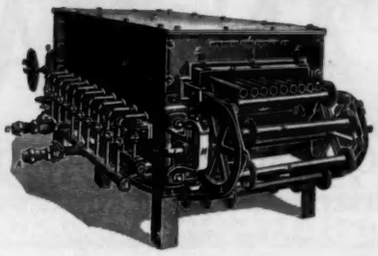
Our Exclusive Specialty. . . .

What drill are you using? I am using the Snyder How do you like it? I think it is the best on earth for all around purposes. Thoroughly well made, quick to operate and does its work accurately.

With ordinary care they will last a lifetime. Look into the merits of this tool. Time is your money. Catalog Free.

J. E. SNYDER,
Worcester, Mass.

It's the Special Business of this Machine



to anneal steel tubing or shafts, and it's the most successful machine that has yet been devised for that use.

The first machine of this kind we designed for the McCool Tube Co., of Beaver Falls, Pa., to operate with natural gas. That company soon ordered three more and explicitly specified that we were "to build the same exactly like the first in every particular."

To properly describe this splendid machine would require nearly a page of the American Machinist, but a full description and a larger illustration of it are in our large catalog, together with other descriptions and pictures of good Gas Furnaces, and the Catalog is free.

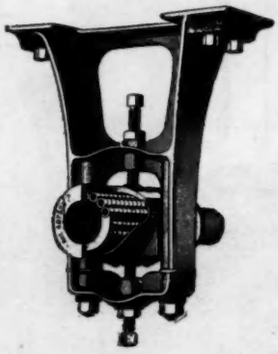
American Gas Furnace Co.

23 John Street, New York.

Want our catalog of Fuel Gas Plants?

Chas. Churchill & Co., London. Hermann Glaenzer & Co., Paris. Schuchardt & Schutte, Berlin and Vienna.

With the Effluxion of Time



prejudice is lessened, reason controls the judgment, and devices which a few years previous were condemned or given but scant consideration, are examined, tested, adopted and recommended.

Investigate the Hyatt Roller Bearing, and begin your investigation with the Hyatt Book, which is free for the asking.

Hyatt Roller Bearing Co.
HARRISON, N. J.
133 Liberty St., New York.

MACHINISTS, ENGINEERS, STEAM AND HOT WATER FITTERS, MILLMEN, MECHANICS GENERALLY

Are urged to look into the merits of our celebrated . . . . . .

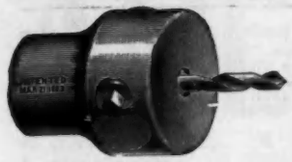
"DUPLEX" ADJUSTABLE DIE STOCKS.

FOR BOLTS

THEY HAVE NO EQUALS.

Send Postal Request for List.

THE HART MANUFACTURING CO.,
120 WOOD ST., CLEVELAND, O., U. S. A.



Style B—Two-Jaw.
Or CHAS. CHURCHILL & CO., Ltd.,
London and Birmingham, Eng.

Ask your nearest Dealer, or send to the Manufacturers for

THE LATEST

IMPROVED DRILL CHUCKS,

Strong, Accurate, Durable, Cheap.

THE E. HORTON & SON CO.,

WINDSOR LOCKS, CONN., U. S. A.

AWARDS AT THE WORLD'S FAIR.

Light Steel Dog

Made by

Wm. G. LeCount,

Successor to C. W. LeCount,
South Norwalk, Conn.

Ask for Catalog A., Machine Tools.
Agents: Chas. Churchill & Co., Ltd., London, England.

"Cushman" Chucks.

We manufacture ten distinct styles of Lathe Chucks, four styles of Drill Chucks, Centering Chucks, Face Plate Jaws and Chucks for special service. Send for new catalog and discount sheet.

The Cushman Chuck Co.

Hartford, Conn., U.S.A.

Skinner "New Model"

Drill Chucks can be taken apart, cleaned and oiled with ease. A screwdriver is the only necessary tool. Have you had experience with THE OTHER KIND? Write for prices, and illustrated catalog—Free.

The Skinner Chuck Co., New Britain, Conn., U.S.A.
94 Reade Street, New York City.

Our Specialty is . . .

Machinery for Making Wood Screws. . . . .

Asa S. Cook Co.,

Hartford, U. S. A.

SCREW CUTTING DIE HEADS.

Self-Opening and Adjustable.

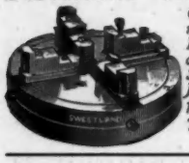
The only mechanically correct automatic Die Head on the market. All leverage entirely overcome. Makes a full and perfect thread in one cut, and besides it can be accurately adjusted. Saves 50 per cent. in time and wear over solid dies. Made for cutting from No. 17 wire gauge to 6 in. diameter, and arranged for any style of thread. Adopted by all principal manufacturers of bicycles and bicycle fittings throughout the country. WHY?
Write us for particulars and prices.

GEOMETRIC DRILL CO., Westville, Conn.

FOR SALE BY
HILL, CLARKE & CO., Boston, Mass., and Chicago, Ill.
THE GARVIN MACHINE CO., New York City.
J. W. CREGAR, The Bourse, Philadelphia, Pa.
R. HOFFELD & CO., Buffalo, N. Y.
THE SYRACUSE SUPPLY CO., Syracuse, N. Y.
THE STRONG, CARLISLE & HAMMOND CO., Cleveland, Ohio.

IN EUROPE BY
CHAS. CHURCHILL & CO., London and Birmingham.
HERMANN GLAENZER & CO., Paris, France.
DE FRIES & CO., Berlin and Dusseldorf, Germany, and Vienna, Austria.

Sweetland Chucks



Of all Descriptions. Combination and Universal, with Patent Reversible Jaws. Independent Chucks, Geared Scroll Chucks, Face Plate Jaws, Machinists' Tools. Send for Catalog.

The Hoggson & Pettis Mfg. Co.
New Haven, Conn.

There's Not a Lame Place

in the Reid Chuck, anywhere—one part is as strong as another. That may be one reason why the "Reid" outwears other chucks.

R. H. Brown & Co., New Haven, Conn.

Errington

F. A. ERRINGTON,
39 and 41 Cortlandt Street,
NEW YORK CITY, U. S. A.

Drives Tap in, stops automatically at bottom of hole, and backs tap out (quick return)

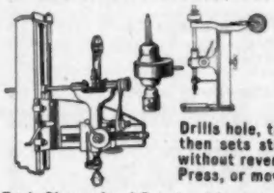
Auto-Reverse

Write for Catalog. "99" MODEL.

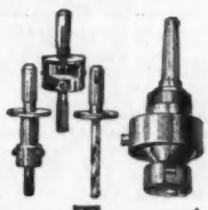
WITHOUT STOPPING OR REVERSING DRILL PRESS. NO REVERSE BELT. EITHER FRICTION OR POSITIVE TOOL-HOLDER.

Tapping Chuck

Fits Socket of ANY Drill Press.



No. 0 taps 1-16 to 3/8.
No. 1 taps 1/8 to 5/8.
No. 2 taps 3-16 to 1.
No. 3 (pipe) taps 1/4 to 1.
No. 4 taps 3/8 to 1 3/8.
No. 5 taps 1/2 to 1 3/4.



Drills hole, taps it and then sets stud in, all without reversing Drill Press, or moving work.

Errington Auto-Reverse Drill Press Turret

Tools Changed and Friction Adjusted while Spindle is Rotating.
MAKES DRILL PRESS A VERTICAL TURRET MACHINE.

England: Charles Churchill & Co., London and Birmingham. Germany: Schuchardt & Schutte, Berlin. Austria: Schuchardt & Schutte, Vienna. Belgium: Schuchardt & Schutte, Brussels. France: Adlphe. Janssens and Fenwick Freres & Cie., Paris.

Our Shops are large.
Our equipment and methods are modern.
20 Years' Experience on Knitting Machinery.

We make a specialty of Manufacturing Light Machinery for Owners or Patentees under contract. Will be glad to correspond with interested parties.

Trump Bros. Machine Co., Wilmington, Del., U. S. A.

Bevel Gears

Cut Theoretically Correct, Special facilities for cutting Worm and spiral wheels.

Hugo Bilgram, Machinist,
440 N. 12th St., Philadelphia, Pa.

"The Reeves" Wood Split Pulley,

with interchangeable bushing system for belt power transmission.

Lighter than an iron pulley. Stronger than a steel pulley. Each pulley will fit thirty-five sizes of shaft. No set screws. No keyway. Complete stocks carried in every jobbing center in the United States. Also

Chas. Churchill & Co., 9 to 15 Leonard St., London, Eng.
Fenwick Freres & Co., 21 Rue Martel, Paris, France.
White, Child & Beney, Vienna, Austria.

Reeves Pulley Co., Columbus, Ind., U. S. A.,
Send for Catalog. Manufacturers.

Split or Wire Chucks

of every description. Special Taps and Dies, all pitches and sizes, with fine threads.
All sorts of small backed off Forming Cutters, Plain Cutters, Reamers, Saws, etc.
Small Turret work in quantities.
Small articles in quantities to order.
Best workmanship guaranteed.
Send for latest complete catalog.

Hardinge Bros.,
1036 Lincoln Avenue, Chicago, Ill.

CUTTING OFF MACHINES,

THE LATEST AND BEST.

HURLBUT ROGERS MACHINE CO.
SO. SUDBURY, MASS.

German Agents: Schuchardt & Schutte, Berlin and Vienna.
English Agents: Chas. Churchill & Co., Ltd. London and Birmingham.

IMPOSSIBLE FOR DRILL TO SLIP WITH A PRATT PATENT CHUCK

The Pratt Positive Driving Drill Chuck

is a necessity for use on old turret machines when the turret holes are out of line with the spindle. The jaws of the Chuck can be partially tightened so that the reamer may float.

The equalizing driver, in which the drill is inserted, ABSOLUTELY PREVENTS SLIPPING, and the jaws align it perfectly with the spindle.

PRATT CHUCK CO.

Send for Booklet. Frankfort, N. Y., U. S. A.

Hampden Corundum Wheel Co.

Vitrified Silicate Elastic **Emery Wheels,** Safety Collars, Wire Webbing, Grinding Machines, Brightwood, Mass.

Index to Advertisers.

	PAGE
Acme Machinery Co	16
Adams Co., The	47
Aibro-Clem Elevator Co	7
Almond, T. R	48
American Gas Furnace Co	2
American Tool & Machine Co	45
American Tool Works Co	5
Armstrong Bros. Tool Co	6
Backus Water Motor Co	49
Baird & Co., Henry Carey	54
Baird Machinery Co., U	48
Baker Brothers	3
Baldwin, Davidson & Wight	47
Ball Bearing Co	16
Barnes & Co., W. F. & John	7
Beaman & Smith	44
Becker Mfg. Co., John	52
Bement, Miles & Co	53
Besly & Co., Chas. H	56
Bethlehem Foundry & Machine Co	54
Bethlehem Iron Co	55
Bickford Drill & Tool Co	55
Bignall & Keeler Mfg. Co	4
Bilgram, Hugo	9
Bliss Co., E. W	6
Blood, L. H	48
Boston Gear Works	49
Bradford Mill Co., The	50
Brandywine Machine Works	2
Bristol Co	56
Brown & Sharpe Mfg. Co	56
Brown & Co., R. H	9
Brown & Zortman Machinery Co	12
Buffalo Forge Co	56
Builders' Iron Foundry	2
Bullard Machine Tool Co	48
Burt Mfg. Co	43
Caldwell Co., W. E	43
Carborundum Co., The	43
Card Mfg. Co., S. W	49
Case Mfg. Co	48
C & C Electric Co	15
Chadwick & Co., G. B	49
Chandler & Taylor Co	54
Chicago Pneumatic Tool Co	11
Cincinnati Mach. Tool Co	7
Cincinnati Milling Machine Co	50
Cincinnati Planer Co	51
Cincinnati Shaper Co	16
Cleveland Gear Works	41
Cleveland Machine Screw Co	4
Cleveland Twist Drill Co	56
Clough, R. M	53
Coffin & Leighton	4
Colcord Machinery Co., W. R	6
Cook Co., Asa S	9
Crescent Steel Co	7
Crosby Steam Gage & Valve Co	7
Cumberland Iron & Steel Shafting Co	7
Curtis & Co., Mfg. Co	51
Curtis & Curtis	4
Cushman Chuck Co	9
Dallett & Co., Thomas H	53
D'Amour & Littledale Mach. Co	8
Davis Machine Co., W. P	16
Dayton Globe Iron Works Co	54
Detrick & Harvey Machine Co	7
Diamond Machine Co	4
Dietz, Schumacher & Boye	52
Dixon Crucible Co., Joseph	7
Doan & Co., J. B	12
Draper Machine Tool Co	14
Dreses, Mueller & Co	52
Dwight Slate Machine Co	55
Eames Co., G. T	8
Eastern Machinery Co	41
Eddy Electric Mfg. Co	51
Errington, F. A	9
Evans Friction Cone Co	47
Faneuil Watch Tool Co	56
Fellows Gear Shaper Co	47
Fifield Tool Co	56
Flather & Co	16
Foos Gas Engine Co	54
Fox Machine Co	16
Frick Co	54
Garvin Machine Co., The	48
General Electric Co., The	51
Geometric Drill Co	9
Gisholt Machine Co	3
Gleason Tool Co	56
Goodyear, S. W	4
Gould & Eberhardt	16
Grant Gear Works	16
Gray Co., G. A	16
Hamilton Machine Tool Co	49
Hampden Corundum Wheel Co	9
Hardinge Bros	9
Hart Mfg. Co	2
Harrington, Son & Co., Edwin	14
Hartford Steam Boiler Insp. & Ins. Co	43
Henderer's Sons, A. L	45
Hendey Machine Co	42
Henley & Co., N. W	45
Hill, Clarke & Co. (Boston)	12
Hoggson & Pettis Mfg. Co	9
Horton & Son Co., E	9
Howard Iron Works	51
Hunt Co., C. W	54
Huribut-Rogers Machine Co	9
Hyatt Roller Bearing Co	2
Ingersoll-Sergeant Drill Co	49
International Correspondence Schools	48
Jenkins Brothers	43
Jones & Lamson Machine Co	1 and 16
Kempsmith Machine Tool Co	4
Keuffel & Esser Co	8
Landis Tool Co	45
Le Blond Machine Tool Co., R. K	56
Le Count, Wm. G	9
Lodge & Shipley Machine Tool Co	41
Long & Allstatter Co	14
Lucas & Griem	16
Main Belting Co	51
Mansfield Machine Works	13
"Manufacturer"	12
Maris Brothers	51
Marshall & Huschart Machinery Co	13
Mergenthaler & Co., Ott	15
McCabe, J. J	12 and 13
Mietz & Weiss	54
Morse Twist Drill & Machine Co	15
Morton Mfg. Co	55
Mossberg & Granville Mfg. Co	13
National Pneumatic Tool Co	55
Newark Machine Tool Works	16
New Era Iron Works	54
New Haven Mfg. Co	8
New Process Raw Hide Co	6
Newton Machine Tool Works, Inc	8
Niagara Machine & Tool Works	46
Nicholson & Co., W. H	55
Nicholson File Co	43
Niles Tool Works Co	12
Niles Tool Works Co. (Hamilton)	13
Norton Emery Wheel Co	49
Oesterlein Machine Co., The	13 and 16
Oster Mfg. Co	6
Palmer Brothers	54
Pearson Machine Co	56
Philadelphia Bourse	51
Pierce Engine Co	54
Pond Machine Tool Co	11
Pond Machine Co., L. W	8
Potter & Johnston Co	6
Powell Planer Co	43
Pratt & Whitney Co	52
Pratt Chuck Co	9
Prentiss Tool & Supply Co	12
Putnam Machine Works	16
Q & C Co	47
Quint, A. D	52
Reed Co., F. E	49
Reeves Pulley Co	9
Reinecker, J. E	5
Rogers Boat, Gage & Drill Works, John	8
Rue Mfg. Co	54
Safety Emery Wheel Co	51
Saunders' Sons, D	48
Sawyer Tool Co	8
Sebastian Lathe Co	48
Sellers & Co., Inc., William	16
Seneca Falls Mfg. Co	8
Shultz Belting Co	16
Sibley & Ware	49
Sittman & Pitt	49
Skinner Chuck Co	9
Slocomb & Co., J. T	51
Smith & Mills	4
Snyder, J. E	2
Speirs & Co., J. C	55
Springfield Gas Engine Co	54
Springfield Machine Tool Co	50
Standard Tool Co	52
Starrett Co., L. S	44
Steel Ball Co	7
Stevens Arms & Tool Co., J	4
Stiles Press Co., E. S	53
Stover Novelty Works	4
Stuart's Foundry & Machine Works, R. J.	56
Tabor Mfg. Co	54
Tight Joint Co	6
Toomey, Frank	45
Towsley Mfg. Co., J. T	6
Trump Brothers' Machine Co	9
Turner, Vaughn & Taylor Co	6
United Correspondence Schools	41
Walker, O. S	56
Ward & Sons, Edgar T	7
Warner & Swasey	56
Watertown Engine Co	54
Watkins Co., F. M	54
Watson-Stillman Co., The	53
Weber Gas & Gasoline Engine Co	54
Webster Mfg. Co	54
Wells Bros. & Co	56
Whitcomb Mfg. Co	49
Whitney, Baxter D	2
Whitney Mfg. Co	14
Whiton Machine Co., D. E	45
Wiley & Russell Mfg. Co	55
Wiley & Sons, John	43
Williams & Co., J. H	48
Winkley, F. D	55
Wood's Sons, T. B	48
Woodward & Rogers	4
Worcester Machine Screw Co	49
Wyke & Co., J	55
Wyman & Gordon	56
York Co., S. M	12
Young Mfg. Co., W. C	4

Contents.

	PAGE
Spring Calculations	17
American Locomotives in England	17
Municipal Ownership of Street Railways	17
Some Lessons of Experience	18
A Novel Lighting Plant. By Peter H. Bullock	18
Commercial Review	19
The Springfield Gas Engine	22
A Positive Drive and Release Tapping Head	24
A Newspaper's Description of the Automatic Fire Sprinkler	24
Portable Boring and Milling Machine	25
Turning Stone	25
Safe Loads for Helical Springs—I. By Robert A. Bruce	26
Compressing Air to Produce a Dry Atmosphere. By Frank Richards	29
Iron Screws in Stone Walls	29
Trial-Rim Dies. By A. H. Cleaves	30
The Rise and Development of the Science of Mechanics	30
Letters from Practical Men: Liquid Air. By W. H. Smyth....A Babbitting Scheme. By Wm. Sangster....Punch and Die Construction. By S. R. Munson....Some Points About Lathes. By J. E. P. ....A Compound Die. By Die Maker....Amateurs' Lathes. By J. H. Ten-Eyck Burr....Re-boring a Large Pulley. By H. C. Davenport. ....Drawing Hexagon Nuts. By Jib, Draftsman No. 2, and Geo. F. Summers....Turning Crank Shafts. By Hugh Hill	33-38
Bolts and Nuts in Scotland	38
Affairs in Russia	39
Incorporation of the Bickford Drill Company	39
Good Workmen at Watervliet	39
Not Killed by Liquid Air	39
Personal	39
Obituary	39
Questions and Answers	40
Technical Publications	40

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION

VOLUME 22 NEW YORK, THURSDAY, APRIL 20, 1899 NUMBER 16

Published at 218 William St., New York
Every Thursday by the

American Machinist Press.

[INCORPORATED.]

JOHN A. HILL, President and Treasurer.
A. LEIGHTON DONNELL, Sec'y.

Editorial Department.

FRED J. MILLER, Chief.

FRANK RICHARDS,
F. A. HALSEY,
EDWARD P. BUFFET. } Associate Editors.

Advertising Department.

C. P. DAY, Eastern Representative.
JOHN MCGHIE, Western Representative.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Never address individuals, send all business communications to the American Machinist Press. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price.

$3 per year in advance, postage paid in North America.
$4 per year in foreign countries, postage prepaid.
No back Numbers beyond current year.
For Sale by Newsdealers, generally.

CHAS. CHURCHILL & Co.,
9 to 15 Leonard St., Finsbury, London,
Agents for Great Britain.

FENWICK FRERES & Co.,
21 Rue Martel, Paris,
Representative for France, Belgium, Switzerland and Italy.

Entered at New York P. O. as second-class mail matter

Spring Calculations.

Elsewhere in this issue will be found the first half of an article on "Safe Loads for Helical Springs," which, in connection with another article to follow on the deflection of such springs, puts, we believe, the entire spring problem on a more satisfactory basis than has before been done. The present article gives first the necessary formulæ for calculating the safe loads, follows these with tables for solving the same problem within the usual range of practice by inspection, and concludes with a diagram for the same purpose. This diagram will appear with our next issue, and, owing to its size, will be given on a separate sheet or insert. The second article, on the deflection of springs, will follow the same line of treatment and will conclude with a similar diagram. In addition to these aids to the solution of spring problems, a table of constants for the usual materials used in spring construction will be given.

The two articles will thus cover the two problems connected with spring design, namely, the safe load and the deflection under any load; and they form, we believe, the most complete, as well as the most easily applied, solution of the spring problem that has ever appeared in print.

Of the many diagrams which we have published, none, we believe, meet a larger need than those belonging to these articles. Not many designers are able to determine the performance of springs in advance, and those who can do it at all are compelled to resort to tedious and cumbersome methods from which the present diagrams will afford welcome relief.

American Locomotives in England.

Recent numerous orders from England for American locomotives and the now famous Atbara bridge contract have stirred up quite a commotion in the "tight little isle," and they are talking of an "American invasion" and of industrial ruin. As the things imported from America are used in British industries it is a little difficult to see just how the invasion can be disastrous to those industries or how ruin can result from it. Locomotives, for instance, are good things for industries—in fact absolutely necessary to their continuance and development. If they can be bought here for considerably less money than at home and can be delivered much more promptly than British builders can deliver them it is not only good business but good for British industries generally that the locomotives should go from here; as they are doing.

As to its effect on British locomotive builders, that is different; but if they are wise the effect will be to stimulate them to buy more American machine tools and use them as they are intended to be used, and thus what may at first seem to them a threatening development of foreign trade may turn out to be beneficent, even for them. But in any event the fact remains that locomotives are good things for an industrial country, and the more promptly they can be delivered when needed and the less they cost the better for industries and the country generally.

Municipal Ownership of Street Railways.

Recent events in Detroit and Toledo naturally attract some attention among those machinery manufacturers that have more or less to do with street railway work. Detroit is about to assume ownership of her street railways, and the newly elected mayor of Toledo ran for office on a platform embodying the principle of municipal ownership of public functions and gained a decisive victory over the candidates of the regular political parties, showing conclusively that the people of Toledo deliberately intend to give such ownership a trial.

This is being called revolutionary and in some quarters is being discussed as though the American people were about to set sail upon an unknown sea without chart or compass; whereas the fact is that such municipal ownership of public utilities is old and familiar abroad, especially in Great Britain, and the people there are well satisfied with its practical working.

It is also called socialistic. No one who does not make a specialty of the matter can, we fear, know what Socialism is, but so far as we understand it, it proposes to abolish competition. The public ownership of public utilities does not, however, abolish competition because there can be no competition in such enterprises, except indeed the competition which sometimes arises between different groups of franchise grabbers and which leads to a little more liberal use of boodle and a blacker mass of corruption than is the rule where only one group of capitalists or promotors seek a franchise and there is therefore no competition.

As far as can now be judged it seems to us that this movement towards the public ownership of public utilities is likely to make some headway here, although this will naturally depend very much upon what degree of success is attained where it is to be tried.

Street car service resembles the post-office department in respect of coming constantly into contact with the people. They can watch it at all points and can know whether it gives satisfactory service or not and what it costs.

Public control of street railways does not, however, necessarily involve their operation by public officials. The plan found most satisfactory in Great Britain is to lease the roads to private companies, to be operated under prescribed conditions and with suitable safeguards for the public interests.

Public ownership if it could or would be generally adopted at once might somewhat lessen the demand for street railway equipment, but it will come gradually if at all, and it seems unlikely that any serious disturbance can result from it. It will be tried in spots and if found not to work well the idea will be abandoned. The American people are not crazy, nor are they imbeciles, and what Abraham Lincoln said of them still holds true.

Some Lessons of Experience.

Once upon a time a well-known engineer who had been successful in the organization and management of manufacturing enterprises found himself without an engagement, and proposed to certain capitalists that they should join him in the establishment of a manufacturing enterprise in a line of work in which he had previously acquired considerable experience. An agreement was made to form a company with a capital of $200,000, $160,000 of which was to be paid in by the capitalists, while the balance of the stock, representing $40,000, was to be retained in the treasury of the company and to be paid to the engineer in installments of $10,000 each, payable at the end of such fiscal years as the business paid a 6-per-cent. dividend upon the $160,000 invested. The capitalists possessed no experience in the line of work proposed to be carried on, and contributed nothing except capital. It was agreed at the beginning that about two years would be required to get the business into shape to pay any dividends, and in case it paid at any time more than 6 per cent., no special compensation was to be paid to the engineer for that other than what he might receive in the way of dividends on stock at the time owned by him. In addition to these stock payments, he received a fixed salary from the beginning of his engagement.

The business was established, and a plant erected and equipped which, when finished, was a model in its way, thoroughly efficient and well calculated for carrying on the work. The machines to be manufactured and the plant for manufacturing them were designed solely by the engineer, who not only did the mechanical and engineering work, but also managed the business end of the enterprise; that is to say, in addition to the engineering work, he conducted all other business of the company, the directors merely holding meetings occasionally and discussing the general policy to be pursued and the prospects of profits in the business. The president of the company took little active part in its management, but kept himself constantly informed regarding the profits on all orders as shown by the books of the company.

At the end of the third year there was sufficient money in the bank to pay a 6-per-cent. dividend and leave a comfortable balance, and our engineer naturally supposed such dividend would be paid, and that he would receive his first installment of $10,000 of the capital stock. To his surprise, however, when the meeting was held, the directors voted to charge off for depreciation of plant an amount sufficient to wipe out the balance in bank and create a deficit, and thus the payment of stock was avoided. The engineer said little about this, thinking that it would come out all right in the end, and at the end of the next year he had an amount in bank sufficient to pay a still larger dividend, and supposed that in this case at least the payment of such dividend could not be avoided. It was avoided, however, by a vote of the directors declaring that the drawings and patterns that had been made and were in use in the works were of no value, and that they should be charged off at the rate of $5,000 per month until their cost was wiped out. This vote again created a deficit. Similar action was taken at the end of the following year for the third time, and finally upon some protest being offered by the man who had organized and built up the business and successfully conducted it, one of the directors told him that the bargain made with him had been too favorable, that he had had nothing to sell to the company in reality, and that the salary paid him ought to be sufficient for the services rendered. Finally the directors failed to re-elect the engineer as manager, and he was therefore out of a position with nothing to show for his services except the salary he had received. Upon submitting his contract to a lawyer, he was informed that the only claim he had in the matter was an equity right, and that something might be recoverable if he had money to spend in fighting the matter and could afford to wait for about ten years for a decision in his favor. This was impracticable, and the matter was dropped.

The lessons contained in this case for an engineer are obvious, probably, and are simply that in such matters nothing can be taken for granted, and that if a contract cannot be secured which a competent lawyer will approve of as entirely protecting one's interests, then it is usually not worth while to go into such contract, but instead to receive a salary designed to discharge all obligations as the work proceeds—a plan which, of course, the engineer in question would have followed had he known that the men he was dealing with would make an effort to evade the plain terms of their voluntarily made contract.

The lessons for directors or capitalists in such an enterprise are to be found in the subsequent career of the establishment. A new man was secured to manage it whose ideas were entirely above the line of manufacturing small machines in quantities upon which the business had been built up. He wanted to reach out for large contracts in the same general line of work, but which involved entirely different methods of manufacture. He secured such contracts, and on every one of them, so far as is known, lost money, and while attempting to carry them out lost also most of his business in the strictly manufacturing line; this having been neglected to the extent of allowing competitors to absorb it. The capitalists soon became dissatisfied with his management, discharged him, and the establishment is now going along without hope of dividends, under the direction of a man who came in with the second management as a typewriter.

Here is a case wherein capitalists were supposed to pay, and really bargained to pay, for services which required that rare combination of mechanical and business ability that is recognized the world over as being of the highest value, and which ordinarily enables its possessor to conduct business for himself and make money; yet here was a group of capitalists who seemed utterly unable to perceive or to understand the value of such services, and who, rather than pay a fair price for them, a price previously agreed upon and which the books showed they were able to pay, chose to stultify themselves by taking action which they must have known they had no moral right to take, thereby not only doing an injustice to a faithful man who had strictly lived up to his agreement, but also, as the event showed, practically wrecking their own enterprise.

A Novel Lighting Plant.

BY PETER H. BULLOCK.

On a recent trip down the east coast of Florida, I heard rumors of a wonderful electric plant driven from a pipe out of the ground, and as it was alleged to be but a mile from the hostelry I was buying on the installment plan, I started to investigate. After going a distance that seemed equal to a Florida mile, I met a genial-looking man in a carriage, and inquired for the above mentioned plant. He at once acknowledged himself to be the owner and offered to drive back the remaining mile or more and show the whole outfit.

The owner is a certain Mr. Smith, of New Jersey, not unknown as an able electrician in that State, and well known as a persistent orange grower in Florida. In fact, he is so persistent that he had men maintain fires every 30 feet during the recent freeze, and so saved his valuable fruit and grove. While he does not crow over his neighbors who slept and lost their orchards, he does seem to enjoy riding down the fine coquina road with orange blossoms in the lapel of his coat. But about the plant. Mr. Smith believes that the crust of Florida is only a cover for an inexhaustible reservoir of sulphur water that has its headquarters somewhere in North Carolina, and that it is only necessary to tap it in order to get an ample supply for domestic and power purposes. With a faith in his convictions that nerved him to the expense and surprised his neighbors, he began boring a 10-inch well, and after sinking it 480 feet secured a flow and pressure that were satisfactory. The pressure is equal to about 30 feet, and the volume sufficient to run a turbine that in turn is belted to a 5-kilowatt bi-polar General Electric generator. There was a regulator attached, but it does not work quickly enough to save lamps from too high voltage if there is much change in load, so Mr. Smith has set the gate right

for all the lamps and lets it run all night. In the morning he opens the lighting switch and closes the domestic circuit, and his family then proceed to cook griddle cakes and polish shirt fronts with equal facility.

The success of Mr. Smith in striking water seems to justify his theory, and as there is a long and wide belt where flowing wells may be sunk, it is quite probable that the source may be, as he thinks, far to the north. It should be remarked that his whole outfit is very neatly housed, and that the tail-race is no more than 10 feet from the tide water in Indian River. The advantage of having a power plant that will run without care or expense is supplemented in this case by an inexhaustible supply of perfectly transparent water at a delightful temperature for bathing.

One hundred and seventy-five miles north of this point, and in the city of Jacksonville, the whole water supply is from flowing wells, there being several 8 and 10-inch wells yielding some 3,000,000 gallons per day. The only monument to the discoverer of the possibility of flowing wells in Florida, a former engineer at the water-works, is a small pipe well, still flowing, that was driven by him some years ago under adverse and discouraging circumstances. The color, taste and temperature are substantially the same as at Mr. Smith's, and at the great spring in the Ockalawala River, in still another part of the State.

Commercial Review.

NEW YORK, SATURDAY EVENING,
April 15, 1899.

DYNAMOS AND MOTORS.

Trade continues very brisk. The few indications that it is not quite so much so as in past months are more than neutralized by the reports of continued increase. The New York manager of one company reported two days ago that since the first of this month he had done about an ordinary month's business. A great deal of power distribution apparatus is being sold, and where orders for new plants of importance are few the call for motors to add to those already installed keeps sellers hustling. One of the men most able to speak with authority upon street railway machinery to be found anywhere pronounces trade in that line eminently satisfactory. Outfits for lighting purposes, except where combined with power, are not in urgent demand at this season. Prices on electrical machinery were in many cases advanced during the winter because of the greater cost of copper, and some of the companies which did not then stiffen rates have done so since. A representative of one company denies that his concern has yet made a change, but states that an advance may be expected any day. In one reported instance a perceptible falling off of orders is attributed to higher prices. Some manufacturers require three or four months time for delivery of the larger electrical machinery, but others are prepared to fill orders much more promptly. While early deliveries are in some instances growing increasingly difficult, in others they are becoming easier. The same diversity of experience is presented in the case of night work. The Bullock Electric Manufacturing Company, as we mentioned last week, has lately had to put its shop upon night turn, and only a few days ago the Crocker-Wheeler Company so increased its schedule of night work that the plant is now running on practically full double turn. On the other hand certain companies which early in the year were keeping a night force busy have discontinued work after dark in whole or in part. In one of these latter cases it is stated that the change did not indicate a falling off in demand.

Export trade in electrical machinery shows many favorable symptoms. English orders continue to blow in freely, denoting active business on the other side. Spanish-American trade, according to the experience of one of the largest electrical companies, which has devoted much attention to that field, has been handicapped by transportation difficulties resulting from the Spanish war, and is retarded by local disturbances in several Central and South American countries. The outlook of business with the Argentine, however, is excellent. Prospects are quite favorable in the Far East, to which region attention is being turned in these days.

The General Electric Company has just received from the British Thomson-Houston Company railway equipment orders for the Bristol Tramways and the London United Tramways, which are considered decidedly important contracts.

As agents for the Shanghai Municipal Council, China, Blackall & Baldwin, 39 Cortlandt street, have received tenders for a condensing outfit. Upon instructions of the Municipal Council, the bid of the Worthington Hydraulic Works has been accepted.

Orders have been received from Paris by a New York electrical house for four large dynamos and other material for an electric road equipment. All told, $32,000 worth is to be shipped to Havre six months hence.

For shipment to Sydney, Australia, $15,000 worth of electrical machinery has been ordered of a local company.

MISCELLANEOUS.

The Ticonderoga Machine Works have completed fourteen large wood pulp grinders for the International Paper Company, Rumford Falls mill, and eight large grinders for the Milton mill. They have orders booked for twelve more grinders and three Butterfield cutting-off saws. A large force of machinists is kept constantly at work.

The Chicago Pneumatic Tool Company writes, under date of April 10: "We have this day received orders for 158 pneumatic tools, including compressors, drills, hammers, riveters, etc. The orders for these tools are from different concerns, including railroads, ship building plants and manufacturing institutions. Our business for March, 1899, was the largest in our history, being considerably more than double that of March, 1898, and the increase for the month thus far is still more marked. The tools are going to parties who are increasing the use of pneumatic appliances in their work, and this increase in trade is a fair index of the general business of the country."

The Weber Gas & Gasoline Engine Company, Kansas City, Mo., reports the following recent shipments: One carload, eight engines, to Southern California for irrigation; one 10 horse-power hoist for Sonora, Mex.; one 25 horse-power hoist for Silverton, Col.; one 10 horse-power engine for Havana, Cuba; one crude oil engine for Porterville, Cal. They have also just finished the installation of a plant, entirely furnished by them, for pumping the sewerage for the city of El Paso, Tex., during flood time of the Rio Grande River. This consists of two direct connected 10 horse-power Weber gasoline engines and two 8-inch Morris centrifugal pumps.

MACHINE TOOL NOTES.

A machine shop equipment, valued at more than $45,000, is said to have been ordered through a local office for shipment to Dundee, Scotland. It includes planers, lathes, drill presses, etc., a large engine and considerable transmitting machinery. The prices which were quoted over six months ago are in almost every case lower than those now prevailing; so it is a question to the recipient of the cable news whether the manufacturers will hold good the quotations given.

A man in close touch with the German market for American tools states as his belief that the maximum demand from that country has already been reached. His particular house, however, has, as yet, felt no falling off. He has up to this time seen little or no withholding of orders as a result of higher prices for machine tools, and remarks that the manufacturers do not seem to have raised their export prices so much as the domestic ones, yet he is of opinion that increases of 10 per cent., such as have been reported on some heavy tools, cannot but cause a hesitation among foreign buyers.

PROVIDENCE NOTES.

The A. Carpenter & Sons Foundry Company has notified its help that a 10 per cent. increase in wages will be made, commencing Monday, the 15th inst. This not only indicates business activity here, but also means that other foundrymen will probably take similar action.

Each department of the old plant of the Rhode Island Locomotive Works is

being started with a small number of men, doing the preliminary work essential to a general resumption of business. It is claimed that the International Power Company has several orders for locomotives, including one lot of twenty-six. In prosperous times these locomotive works have employed some 1,300 men.

The Armington & Sims plant is being closed for the present.

CHICAGO MACHINERY MARKET.

The character of present trade in machine tools is mainly small lots to old patrons. The general verdict among sellers is that shops are buying one, two or three machines, to be used as an addition to their previous equipment, to help them with large contracts assumed. They are not yet throwing out the old machines to any general extent, but finding additional room somewhere for the new ones. This betrays a very conservative attitude on the part of the buyers. The latter are undoubtedly busy or more than busy. But the question which they are facing is, Will the current activity extend through a series of years or will it cease in the near future, to be followed by an easier state of trade? New business is now perhaps a shade or two lighter than for several previous months. When the buying movement begins again then the hesitation of the doubting Thomases is to be dispelled, and more vigorous buying is to begin. That is a theory which is held here.

But while present business is largely of the small lot order, it aggregates a very respectable total. And the statement made above that sales are not displacing old machines does not represent the whole truth. In fact there is now considerable old machinery in the market, possibly not so much as several months ago, but enough to affect the market in a small way. The more active condition of the market has brought out some equipments that the owners were waiting for a propitious occasion to unload. Ordinarily this second-hand material goes to the small shops. Just now the ruling lateness of deliveries is causing needy buyers to put in an old machine when it can be obtained rather than wait from three to nine months for one direct from maker's shop. The railways are fair buyers, but the maximum degree of activity from that source has not yet been reached from all accounts. The old tool is still a familiar object at many of the shops, even where the economical advantage of the newer machine has been demonstrated. And this condition gives promise of better things in the future. Prices of machine tools continue to advance, not uniformly, however, for makers who are not well known to fame are less burdened with orders than their more fortunate competitors, and are often in a position to accept business for early delivery. Assortments at store are broken and very hard to replace.

The Q & C Company is working its shop overtime and is on an average ninety days behind its orders for machinery. It is making a large shipment of pneumatic tools to Russia and of pneumatic tools and saws to London and to Paris.

The Chicago office of Manning, Maxwell & Moore has just sold, for the equipment of the new shops of Shickle, Harrison & Howard Iron Company at East St. Louis, five Shaw electric cranes.

Dawson & Goodwin say that their business in machine tools has been better during the past three months than for any similar period in their history.

McDowell, Stocker & Co. have this week shipped machinery from this city to New York. Among their other sales were an 84-inch lathe to the Woolley Foundry & Machine Company, and a 54-inch engine lathe to the Otis Steel Company, Cleveland.

NORTHWESTERN NOTES.

A representative of the "American Machinist," who is traveling in the West, has received the following reports of activity prevailing among manufacturers in Wisconsin and vicinity:

At the Gisholt Machine Company's Works, Madison, Wis., orders for their lathes and tool grinders have never before been so numerous as at present. They have a new building under construction which will enable them to carry out many new ideas that lack of space has hindered hitherto. They report an especially encouraging demand from Europe.

F. D. Winkley, Madison, manufacturer of oil hole covers, is rushed with orders, and the covers are being shipped to all parts. He also meditates an increase of factory space.

The Pearson Machine Company, Chicago, continues to have a steady, large demand for screw machines, with an outlook still more encouraging. It looks for no immediate fall in the demand, and is preparing accordingly.

The Steel Ball Company, Chicago, reports demand for steel balls in many unlooked-for quarters. It is turning out almost a million a day, and expects with the perfected machinery recently developed to exceed this. The balls are proving successful competitors to those made in Europe, on none of which so close a guarantee as one ten-thousandth of an inch can be given, it is said.

The George Gorton Machine Company, Racine, Wis., reports a good demand for disk grinders.

Kearney & Trecker, Milwaukee, Wis., have had a large number of inquiries for their multiple spindle hub-drilling and tapping machine, illustrated and described in the "American Machinist," February 16, several coming from Europe, and are preparing to meet a considerable demand for machines of this character.

Pawling & Harnischfeger, Milwaukee, have built over fifty traveling cranes since January 1, 1899, among them ten shipped to St. Petersburg for the Russian Government, one to Sweden, four to Japan, and one to Vienna. They are now engaged in erecting a new building to increase their facilities.

The Filer & Stowell Company, Milwaukee, is overwhelmed with orders and working overtime to keep up. They are doing an extensive foreign business.

The Edward P. Allis Company, Milwaukee, is in a similar condition, especially as regards its larger units.

The Manville Covering Company, Milwaukee, has arranged hereafter to represent the H. W. Johns Manufacturing Company in the West, while the latter company will handle the goods of the Manville Company in the East.

The William Bayley & Sons Company reports its factory filled with work in meeting the large demand for its shop heating and ventilating systems.

The Berlin Machine Works, Beloit, Wis., have their factory filled with orders for both heavy and light wood-working machinery. Their experience is by no means universal in their line, for many wood-working machinery manufacturers report business as slack.

Quotations.

NEW YORK, Monday, April 17.

Iron—American pig, tidewater delivery:—

Pennsylvania irons:

No. 1 X foundry	$16 75 @ 17 00
No. 2 X foundry	15 75 @ 16 00
No. 2 plain	15 25 @ 15 50
Gray forge	14 75 @ 15 00

Alabama irons:

No. 1 foundry	16 00 @ 16 50
No. 2 foundry	15 50 @ 16 00
No. 3 foundry	15 00 @ 15 50
No. 1 soft	16 00 @ 16 50
No. 2 soft	15 50 @ 16 00
Foundry forge	14 50 @ 15 00

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.50 @ 1.55c., nominally; refined, 1.58c., upward. Store prices: Common, 1.70 @ 1.75c.; refined, 1.75c., upward.

Tool Steel — Base Sizes — Standard quality, 6 @ 7c.; extra grades, 12 @ 14c.; special grades, 16c. and upward.

Machinery Steel — Ordinary brands, from store, in small lots, 1.95 @ 2.00c.

Cold Rolled Steel Shafting—Base Sizes, from store, in small lots, 2.75c.

Copper—Carload lots, Lake Superior ingot, 18½ @ 19c.; electrolytic, 17¼ @ 17¾c.; casting copper, 17 @ 17½c.

Pig Lead—Carload lots, 4.32½ @ 4.35c., f. o. b. New York.

Pig Tin—For 5 and 10 ton lots, 25⅛c., f. o. b. New York.

Spelter—In carload lots, 6⅝c., New York delivery.

Antimony—In cask lots and over, 9⅞ @ 11c., according to brand and quantity.

Lard Oil—Prime City, present make, 43 @ 46c., in wholesale lots.

FIG. 1. MAIN MACHINE SHOP, SPRINGFIELD GAS ENGINE COMPANY.

FIG. 2. ASSEMBLING AND TESTING ROOM, SPRINGFIELD GAS ENGINE COMPANY.

The Springfield Gas Engine.

Springfield, Ohio, whose greatest fame in the past came from making reapers and mowers, is rapidly approaching equal relative importance in the production of internal combustion engines. No less than four concerns in that city are actively engaged in their construction. One of these confines itself exclusively to making engines for driving pumps in the oil fields.

It may be of general interest in this connection to explain the method of using the gas engine for pumping petroleum. Referring to the sketch, Fig. 8, a hole is bored through the drift to bed-rock. This hole is fitted with an iron casing. A somewhat smaller hole is then drilled through the rock until oil is struck. The pump barrel is then lowered to the bottom. Sufficient gas escapes between the pump barrel and outer casing to more than supply the engine which drives the pump.

Shouvlin Bros. make an engine exclusively for this service. As to the reliability of the gas engine under pressing conditions, Mr. Shouvlin states that he has known these oil-well engines to run continuously night and day for thirty days without a stop. An immense saving in operating expenses has been made possible with the advent of the gas engine in the oil fields.

The enormous Whitely reaper works, covering thirty acres with substantial buildings, lay for years after Whitely's failure, a monument to the ambition of "the captain of the reaper industry." The plant which originally cost millions was finally bought by Senator Fairbanks, who proceeded to install a number of manufacturing establishments. The once great reaper shop is again a veritable industrial city. There are three gas-engine shops, two foundries and general machine works, one machine-tool works, chemical works, etc., and still room for as many more. The motive power everywhere is the gas engine, with natural gas, which reduces the cost of power to an insignificant item.

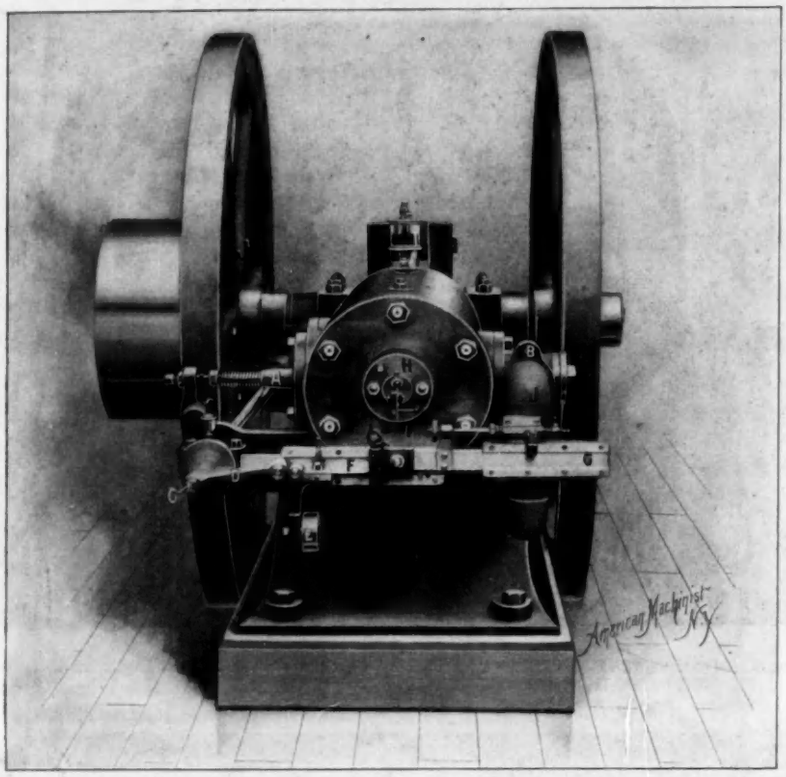


FIG. 3. END VIEW OF SPRINGFIELD GAS ENGINE SHOWING VALVE MECHANISM.

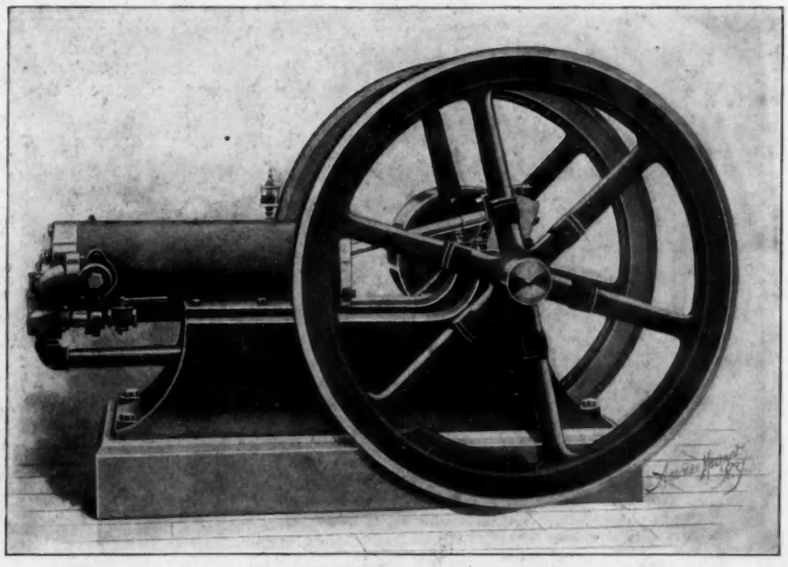


FIG. 4. SPRINGFIELD GAS ENGINE.

The Springfield Gas Engine Company's works are located in the other end of the city, and the company was recently installed in the new buildings.

Fig. 1 is the machine shop, which is 45 feet by 120 feet. Fig. 2 is the erecting and testing shop, 35x115 feet. The old Springfield engine was designed by Messrs. Paxon & Coffield. The latter is now connected with the Callahan Works, of Dayton; while Mr. Paxon, who is still with the Springfield Company, has recently designed the engine illustrated in Figs. 3 to 6. This is the standard engine now manufactured by this company. It is a very good looking engine of ingenious and substantial construction.

Referring to Fig. 3, the cam shaft is driven by spiral wheels of equal diameter, with teeth of 30 and 60 degrees inclination. A convenient fixture for milling these gears was described in the "American Machinist" of December 8, 1898. This milling machine, with fixture, is nearest the observer in Fig. 1. Referring to Fig. 3, the principal parts are as follows: Exhaust valve *A*, suction valve *B*, igniter plug *H*, governor weight *E*. *G* is a slide bearing part of the igniting device *I* and a cam (not seen in the engraving) for operating the gas valve. *C* is a pin on the end of the cam shaft, which, through a link *D*, moves a slide *F* and the governor weight *E*. J is the mixing chamber. Weight E controls a knife-edge, so that with engine running at normal speed, slide *G* moves with slide *F*, thus effecting a spark and an opening of the exhaust valve every alternate revolution; while with a slight excess of speed slide *G* remains stationary, thus shutting off the gas and also missing a spark. The valves are flat-faced, placed horizontally in detachable cages of cast iron.

These valve cages have a taper fit of 1½ inches per foot, and require no packing. The admission valve is opened by suction. It has on the end of the stem a piston

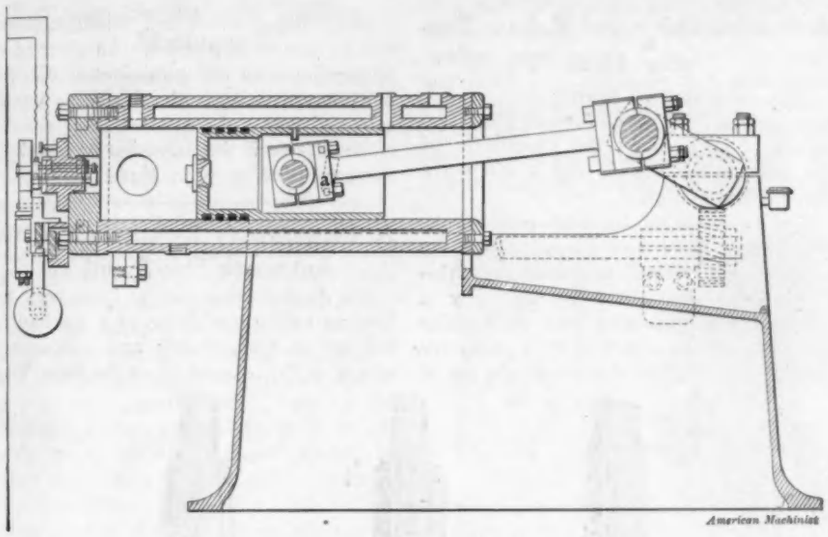


Fig.5.

LONGITUDINAL SECTION OF SPRINGFIELD GAS ENGINE.

injects measured amounts of oil into the mixing chamber. The combustion chamber is compact and free from ports. Study of this machine shows that it is carefully designed to facilitate accurate and easy construction. The base plate is molded without any coring whatever. The cylinder is finished all around, except on the bottom, at one chucking. A special horizontal boring machine is used for this. The openings for the valve cages are concentric, and are finished on a drill press. Two tools with shanks to fit the drill spindle are used for this. The first takes straight cuts through the inside and outside metals; the second is a reamer, tapered 1½ inches per foot. The valve cages are turned to taper on a lathe, and are then ground in place to a tight fit.

They finish their fly-wheels on a boring mill, and polish them after the engine has been started on the testing blocks. The

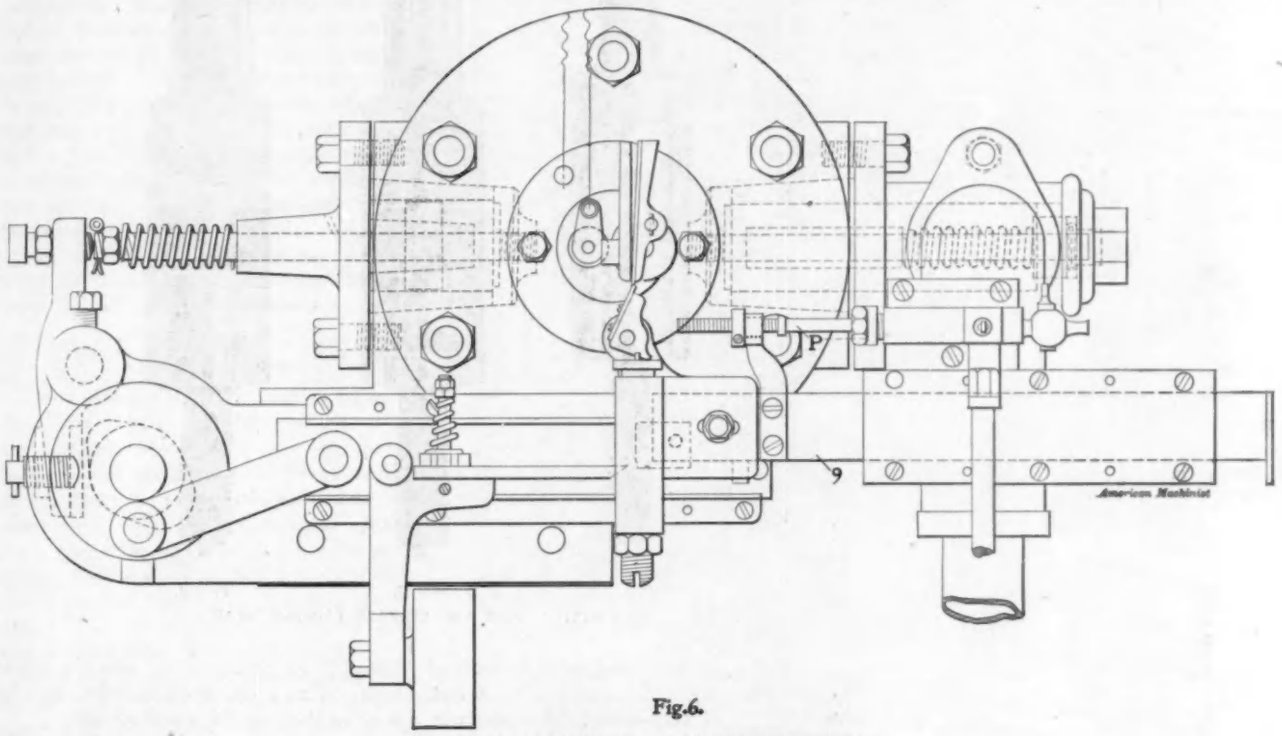


Fig.6.

SPRINGFIELD GAS ENGINE—GASOLINE ATTACHMENT.

head fitting in a bore, for cushioning the valve when seating. This seems to be a good way of quieting the valve as well as preventing wear. The valves are of cast iron and are screwed to the stem and riveted. The over-traveling exhaust is used. The opening is shown in dotted lines at A in Fig. 5. The cylinder head is water-jacketed. The main journals are babbitted, while the crank and wrist-pin journals are of phosphor bronze. The length of the piston head is twice the bore, and the stroke is one and a half times the bore.

Fig. 6 shows the attachment for using gasoline. *P* is a small plunger whose stroke can be nicely regulated, and which

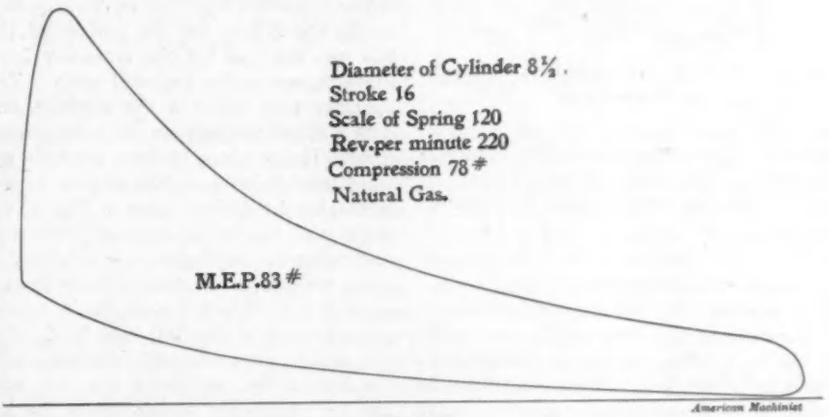


Fig.7.

DIAGRAM FROM A NEW SPRINGFIELD GAS ENGINE UNDER TEST.

main journals on these engines have ring oilers.

The following are the general dimensions of a standard 25 B. H. P. engine:

Cylinder—11x20 inches.

Main journals—4½ x 8¾ inches.

Compression—About 75 pounds.

Piston speed—600 feet.

Speed of air through ports—9,600 feet per minute.

Crank pin—4½ inches diameter by 3¼ inches long.

Wrist pin—3 inches diameter by 5 inches long.

Fig. 7 is a card taken by the writer from a rated 15 B. H. P. engine an hour after it had been first started. The fuel is natural gas. The compression of 78 pounds is rather higher than was expected, but

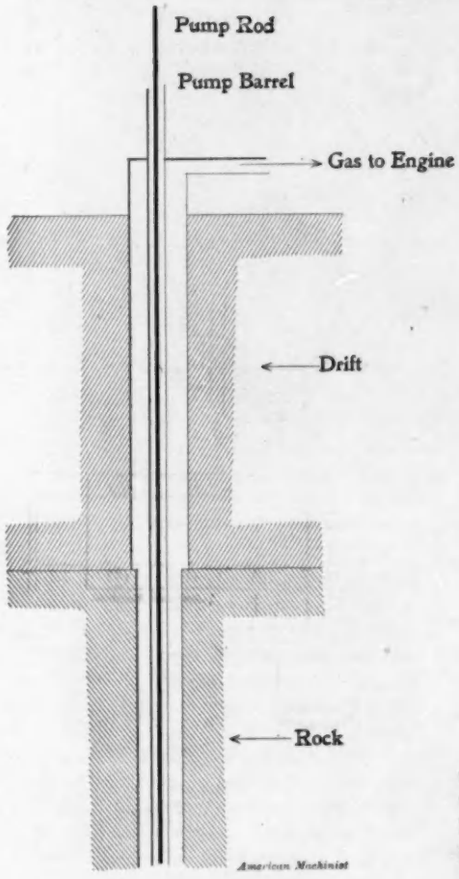


Fig.8.

ARRANGEMENT OF PIPING FOR GAS ENGINE IN PUMPING OIL.

may be due to the fact that the engine was very hot when this card was taken. At 220 revolutions the indicated horse-power is 19.5. B. A.

A company located in this city is offering to treat the interior of gun-barrels chemically so that they will be much less liable to erosion, pitting or rusting than before treatment. This is said to be effected by chemical means, and to involve no heating except that due to a few boilings in water.

A Positive Drive and Release Tapping Head.

The accompanying illustrations show a new tapping head which appears to possess merit. Fig. 1 shows the appearance of the head, while Figs. 2 and 3 will make the construction plain.

The tap is of the ordinary pattern, except that it has a hole down through the center. It is inserted in a head-piece, this head-piece being held in place by a screwed pin projecting into its annular groove, and being driven by a cross-key which is held in the slot across the top of the head-piece by a pin and spring—all of which are clearly shown in Fig. 2. A rod, having a head to prevent its dropping out, passes through the tap, its head being just below the cross-key. It is obvious that as the tap approaches the bottom of the hole the rod will lift the cross-key from the slot, when the tap will stop. The operator then reverses the machine and puts a slight pressure on the quick-return lever. The result is, to draw the body upward until an offset in the annular groove in the tap head-piece, seen in Fig. 3, engages the pin which projects into this slot, when the tap begins to revolve and is withdrawn from the hole. When the tap is started in the next hole, it, of course, stops as soon as the teeth take hold, when the spindle revolves until the slot across the top of the tap-head comes fair with the key, when the spring forces the key into engagement and the tapping proceeds.

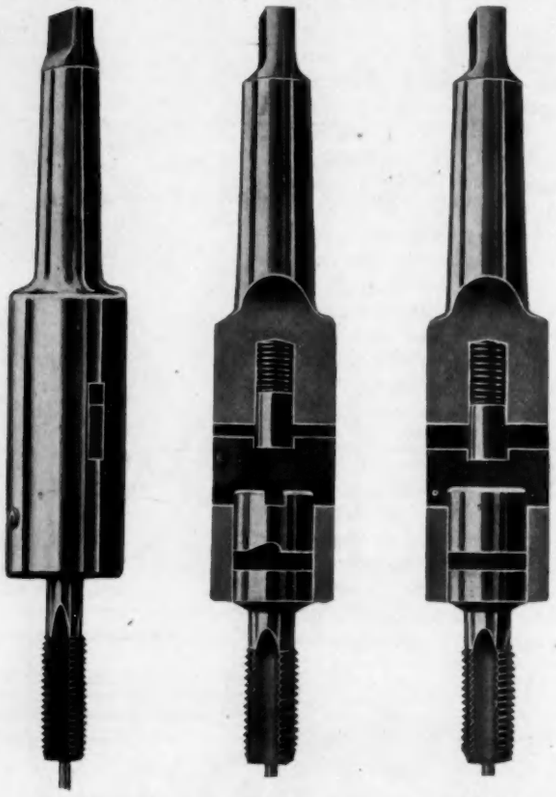


FIG. 1. FIG. 3. FIG. 2.

POSITIVE DRIVE AND RELEASE TAPPING HEAD.

Both engagement and disengagement will be seen to be positive. An assortment of tap heads of different sizes is all that is necessary to adapt the device to a wide range of taps.

The device is the invention of Ralph L. Morgan, of Worcester, Mass.

A Newspaper's Description of the Automatic Fire Sprinkler.

We do not remember to have seen before an article pertaining to a mechanical subject so unanimously and grotesquely wrong as this extract from the New York "World" of February 19, which a friend sends in as a specimen of what may be done in that line by a real genius:

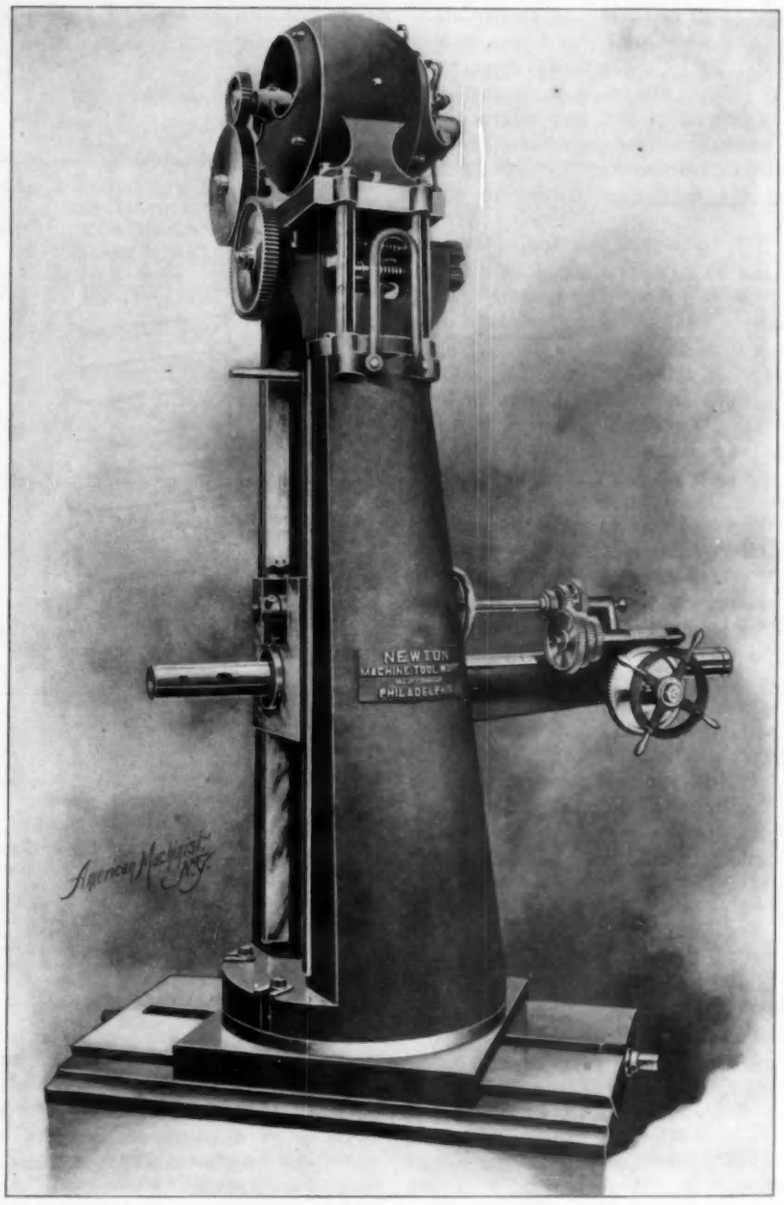
"In some stores buckets, sprinklers and chemical extinguishers are ready for use. A few firms prefer the overhead sprinklers. They are more complicated. Running along all the ceilings are small, white-painted pipes. At intervals are small wheel-like protuberances like the nozzle of a lawn hose. When a fire is discovered, the head of the department is notified. He telephones to the chief engineer. The engineer immediately starts up the automatic pump, which fills the pipes. The superintendent then breaks the proper glass disk, and the sprinkler that covers the spot where the fire has started sends forth its spray. Meantime the men in the special brigade have caught up their axes, hose and buckets, and in less than two minutes from the time of the first alarm the full extinguishing force is at work."

Portable Boring and Milling Machine.

The accompanying half-tone represents a new addition to tne equipment of portable machine tools in use at the Schenectady, N. Y., works of the General Electric Company. Some of these peculiar tools have been shown in our columns before. They are used in connection with the heaviest class of generator work. The parts are strapped down to a large floor-plate and the machines are bolted alongside. The various machines are used in succession without disturbing the work—each tool being supplied with a bale whereby it is conveniently lifted about by the overhead crane. The driving is in all cases by an attached electric motor, to which connection is made by conveniently placed sockets.

The present machine has an assortment of feeds lengthwise of the bar for boring and vertically for milling. One of the leading uses of the machine is the milling of dovetailed slots in the frames of large generators to which the pole pieces are attached. The machine will be seen to be mounted on a base-plate on which it has both a swiveling and a traversing motion. The capacity of the machine will be gathered from the fact that the boring bar is of 4 inches diameter and has a longitudinal feed of 32 inches.

The machine was built by the Newton Machine Tool Works from designs by Mr. John Riddell, of the Schenectady works.



PORTABLE BORING AND MILLING MACHINE.

Turning Stone.

The following from an English publication (the identity of which we regret to say has been lost, so that we are unable to give full credit) would seem to indicate that the machinist is wanted in the stone yard. The writer evidently speaks from intimate knowledge, but the processes and tools described are decidedly primitive, and would bear much improvement. The stone spoken of is very soft and without grit. The writer says:

"For tools, some old three-square files are required. The best thing to do with these is to soften them first by putting the ends into the fire until they are of a dull red color, then throwing them into the ashes to cool gradually. The reason for this is because the stone cuts the tools away very fast, and if they were hard it would mean that you would have to pay frequent visits to the grinding stone to sharpen them. By having them somewhat soft they can be filed up in a minute or so without leaving the place at all. Simply lay them face down on the rest and file away the back. Having, say, three files softened, file one to a point like a V, another to a rounding edge like a gouge, and the other to a square edge. Many moldings can be worked with these three simple tools.

"A chisel is also wanted, say an inch carpenter's chisel, such as every mason has with him in constant use. Also an old worn-out plane iron for finishing the straight parts with. The stone by itself will not run in the lathe, as the material is not hard enough to hold the centers. To obviate this difficulty get two square nuts suitable for an ordinary ¾-inch bolt and let one into each end of the stone in the center. It is necessary that these nuts fit the stone fairly well without shaking about. Then bore with a common drill a ½-inch hole about 1½ inches away from the nut on one end. Drive a plug of wood into this and turn a stout screw partly into the wood, leaving about an inch standing out. This is to meet the carrier on the lathe and to drive the stone around. Oil the other end before putting in the lathe, and then put it in position and screw up moderately tight. Then begin the work by using the V-shaped tool first, and bring it down to a circular form all along and get your ends nearly to the size required when finished. Now lay it out. This is done by having a piece of thin wood like a lath. A lath would do, but it is better for being planed. Lay this lath on your drawing and mark off each member by making a line where the quirks come for the beads, and where the edges come for the hollows. Square these lines across the lath; make the marks plain, as the stone dust soon rubs out faint ones. Hold this stick up against the work and revolve it slowly, and pencil off the lines as you have them on the stick. Now, with your V-tool, mark in these and sink away with the gouge tool any parts that are wanted smaller. If you have a lot to cut away you need not trouble to turn it all away to dust; simply run the gouge into the work in a series of grooves about ½

inch apart and then stop the lathe and gently tap the remaining pieces with the side of the tool, and you will find they will break off with just no trouble at all. Don't run your grooves as deep as you want to go by about ⅛-inch, as they may pluck a little. Pluck is another trade term, and is used to describe what happens when a mason takes off too much with his chisel, and the chisel or other tool, being unable to cut so much, tears it out deeper than is wanted. So be careful and don't have plucks. When the stone is roughed out into nearly its proper form sharpen the tools and take a light cut for the finishing one. It is also necessary to shift the rest nearer the work after cutting so much away. The rest should be from ¼ inch to ½ inch away from the largest part. It need not be straight along. One end can often be placed pointing inward toward the work. The main thing is to keep near enough so as not to have a slip. When a slip is made, the point of the tool catches in the work and tears out more or less. The handle generally comes up in a hurry, very often being stopped by the turner's chin or some part of his face. However, these little mishaps all have their uses and tend to make one careful. Finish the squares and little fillets with the chisel, taking care to have the corners sharp; for any long rounds, or for the shaft, or for flat bands, the old plane iron will be useful. Now, with a piece of coarse sandpaper, go over the work and take off just the rough marks left by the tools. Don't do much with this, or the beads will be flat and the sharp arrises lost. Then, last of all, cut down with the V-tool your shoulders or ends, as the case may be. Go down as far as you can, and undercut just a little. Then carefully remove the work and see how much superior it is to any possible work done by hand."

Safe Loads for Helical Springs—I.

BY ROBERT A. BRUCE.

Most designers at some time or other in their lives have to calculate the dimensions of springs, and all who have had much to do with them will admit that the treatment of this question in pocketbooks is meager and unsatisfactory, and that not until search for data has been made in many quarters does the problem become easy.

The forms of springs are protean, but by far the most usual type met with is the cylindrical helical spring used either in tension or compression. For the present therefore discussion will be limited to that type. Ultimately for any given spring the conditions to be fulfilled resolve themselves into the following:

(1) That for a given change (extension or contraction) in length, there will be a given change in the force exercised by the spring (tension or compression);

(2) That the spring chosen to fulfill condition (1) shall also be within those limits of space or weight necessitated by the design; and

(3) The spring must be of such dimensions that under its maximum load the greatest fiber stress does not exceed a limit depending on the physical qualities of the material used.

It will be noticed that in (2) the conditions are that the diameter of the coils

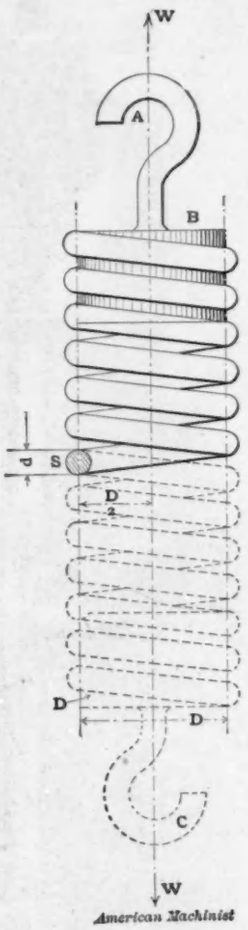


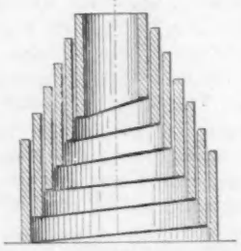
FIG. 1. HELICAL SPRINGS.

shall either exceed or fall within a limiting diameter, and that the length shall be suitable. The first of these, viz., the condition as to diameter of the helix into which the wire is coiled, is perhaps the most suitable one to fix tentatively, modifying it at a later stage if the other conditions cannot be conveniently fulfilled.

Having then provisionally fixed upon the diameter of the helix D (see Fig. 1), the first operation is to calculate the diameter or dimensions of the section of wire or rod. For general purposes there are but two forms of section—round and square; broadly speaking, the former of these is used where weight rather than space is the prime consideration. In cases, however, where space is of prime importance and greater weight does not matter, the square section should be selected. If neither weight nor space conditions are pressing, the fact that, weight for weight, the circular section is better, suggest, as a rule of economy, that, if other conditions do not intervene, the circular section should be always used. The relative economy of these sections will be given later. Other regular forms are possible, but they are rarely used, though one of them (hollow circular section) gives the best possible disposal of material for a given weight of spring; they are (a) hollow circular section, (b) rectangular section, and (c) elliptical section.

Fig. 1 shows a helical spring with the notation employed hereafter. The top half of the spring is in equilibrium under the action of the upward force W, acting axially on A, and the forces on the section at S. Obviously these are reducible to a shearing force W, over the section, and a twisting couple $W \times \frac{D}{2}$. The effect of the shearing force is small compared with the twisting force, and the latter need only be considered in determining the diameter of the section. Hence the operation of finding the safe dimension of section resolves itself into choosing a section which can, without overpassing the safe limit of shearing fiber stress, be subjected to a torque equal to the maximum load on the spring multiplied by the radius of the helix. It should be noted that this theory, though accurate enough for practical purposes, is not mathematically correct, because of the angle at which the coils lie, the effect of this being to give a small couple tending to twist or untwist the coil.

Since this angle is small except in special circumstances, where a wire of relatively large section is wound in open coils of relatively small helical diameter, the latter couple is small and can be neglected in investigations about strength. Its importance, however, must not be overlooked in estimating the twisting that takes place of one of the coils relatively to the other—i. e., the plane of the hook A, in Fig. 1, does not remain at a con-



VOLUTE BUFFER SPRING.

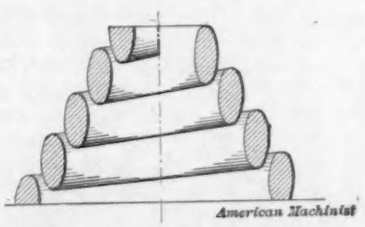


FIG. 2. CONICAL BUFFER SPRING.

stant angle to the plane of the hook *C*.

In calculations of strength the angle may be neglected, and the practical designer may contentedly confine himself to the following very simple rule.

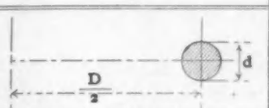
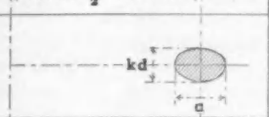
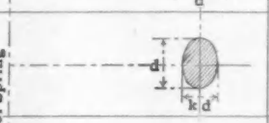
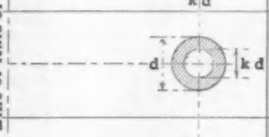
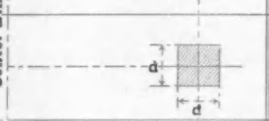
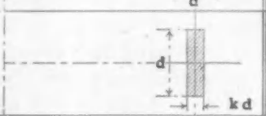
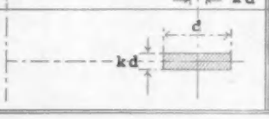
Rule for Strength of Cylindrical Spiral Springs.—The section must be sufficiently strong to withstand a twisting couple, equal to $W \times \frac{D}{2}$, where W = maximum load on spring, and D = diameter of the cylindrical surface on which the helical center line of the spring is traced.

In Table I is given all information for a square section sustains about three-quarters (73 per cent.) of the load safely borne by a circular section.

Some exception may be taken to the expressions used for the strength of the square section; for equal values of d and D, it will be seen that the axial loads are in the ratio of .416 in the case of square to .3927 in the case of round section. No hesitation, however, will be felt in using the results given, as they are mathematically correct. The author has discovered that a series of curious errors with respect to the torsional strength of square sec-

mate expression is given in Table I, but this must be used only in cases where the ratio of the shorter to longer side of the rectangle is less than one-tenth.

With regard to the values of f allowable, much must of course depend upon the particular qualities of the material and its method of manufacture. Generally speaking round sections are often drawn and are less affected by the process of coiling than rectangular or square sections. A higher value of f can therefore be chosen. Rankine suggested that f should be taken at 30,000 pounds per square inch,

FORM OF SPRING D = HELICAL DIA.	SAFE AXIAL LOAD IF f = MAX. SHEARING STRESS	DIAMETER OR SIDE OR VALUE OF d TO CARRY AXIAL LOAD W. STRESS = f	RELATIVE AREAS FOR EQUAL LOADS		RELATIVE SAFE LOADS FOR EQUAL AREAS	
			(Area of Section if W = 1, D = 1 and f = 1	Value of k, and % Value of Area	Load if Area = 1 D = 1 and f = 1	Value of k, and % Value of Load
	$.3927 \frac{d^3 f}{D}$	$1.3655 \sqrt[3]{\frac{W D}{f}}$	1.4644	100%	.5642	100%
	$.3927 \frac{d^3 f k^2}{D}$	$1.3655 \sqrt[3]{\frac{W D}{f k^2}}$	1.8451	if k = .5 126%	$.5642\ k^{\frac{1}{2}}$	k = .5 70.6%
	$.3927 \frac{d^3 f k^2}{D}$	$1.3655 \sqrt[3]{\frac{W D}{f}}$	1.6119	if k = .75 110%	$.5642 \sqrt[2]{k}$	k = .75 86.6%
	$.3927 \frac{d^3 f (1-k^4)}{D}$	$1.3655 \sqrt[3]{\frac{W D}{f(1-k^4)}}$	1.1467 .8259	if k = .5 78.2% if k = .75 56.4%	$.5642 \frac{1-k^4}{(1-k^2)^{\frac{3}{2}}}$	k = .5 144 %
	$.416 \frac{d^3 f}{D}$	$1.3395 \sqrt[3]{\frac{W D}{f}}$	1.7944	122.5%	.416	73.8 %
	$k \leq .1$ $.6666 \frac{d^3 f k^2}{D(1+k^2)}$	$1.1447 \sqrt[3]{\frac{WD(1+k^2)}{f k^2}}$	2.1611		$.6666 \frac{\sqrt{k}}{1+k^2}$	
	$k \leq .1$ $.6666 \frac{d^3 f k^2}{D(1+k^2)}$	$1.1447 \sqrt[3]{\frac{WD(1+k^2)}{f k^2}}$	2.8420	if k = .1 194%	$.6666 \frac{\sqrt{k}}{1+k^2}$	

American Machinist

TABLE I. FORMULAS FOR CALCULATING THE STRENGTH OF SPRINGS.

calculating the dimensions of section to sustain a given load, imposed on a spring of given helical diameter, or for calculating the load which a given spring, all of whose dimensions are fixed, can bear.

The symbols used are:

D = diameter of helix or diameter of spring from center to center in inches.

d = maximum diameter or side in inches.

f = safe shearing stress of the material in pounds per square inch.

W = axial load on springs in pounds.

The columns of "Relative areas" and "Relative safe loads" will also serve as a guide in determining the relative economy of various forms of section.

For example, to sustain a given load the area of a square section is nearly one and a quarter times the area of a circular section of equal strength. For equal areas

tions have a common origin in a mistake made by Rankine and copied time after time by other writers.

Unwin, Cotterill and other correct writers have noted this error and given the correct expression, viz., $T = .208 d^3 f$, but the seal of Rankine's authority has been set upon the erroneous value which has appeared and it still makes its appearance in many unexpected quarters including the British Board of Trade rules for safety-valve springs.

The strength of rectangular sections has been ignored by most writers and the approximate formulæ are mostly worthless. St. Venant's memoir is in fact the sole reliable source of information. A most unfortunate misprint in Thomson & Tait's "Natural Philosophy" invalidates the value of much of the information given in their treatise on this head. An approxi-

but this would seem to be an excessively low estimate of the elastic stress limit of good steel. Hartneel (Proc. Inst. Mech. Engrs., August, 1882) found that experience with good steel springs warranted a value of f from 60,000 to 70,000 pounds per square inch for ⅜-inch to ¼-inch round wire, and 50,000 pounds for ½-inch wire; generally speaking 40,000 pounds may safely be chosen for all cases which usually occur, and the higher values may be adopted when care is taken in the choice of material, and if the diameter does not exceed ⅜ inch. A value very generally adopted and which has been incorporated in the Board of Trade (English) rules for safety-valve springs is $f = 20{,}000$, nearly corresponding with the rule $d = \sqrt[3]{\frac{WD}{8000}}$ for round sections. This value is excessively safe, and de-

signers who wish to make the best use of material will do well to take the higher values given above.

For phosphor bronze springs no very reliable values of f are obtainable, as the material is very variable in its physical qualities, which vary according to its exact composition and its physical treatment during manufacture. Prof. John Perry, who has had much experience in the use of this material for delicate springs, considers it the best non-magnetic material for springs in existence. In practice he finds that in order to free it from the initial strain received in manufacture it should be subjected to a considerable set in the direction in which it will be most usually strained. Probably $f = 7{,}400$ is the highest value which should be used for this material, and then only with caution. All statements as to the strength of this and similar alloys must be taken with caution. Very hard and unannealed phosphor bronze has been known to possess extraordinary tenacity. A special experiment should really be made before settling the stress values to be allowed for any line of springs made from this material. Many small springs are made by coiling hard drawn brass wire. The strength of brass may be almost anything according to composition, but good material may be subjected to a shearing fiber stress of 2,300 pounds per square inch.

Table II is almost self-explanatory. For various values of f, given at the head of the proper columns, the value of Safe Stress × Diameter of Helix is given in the column below, for round or square sections, whose dimension (diameter or side) is given in the left-hand column. To find the safe load for round or square wire of a certain size used in a spring of certain helical diameter, follow along horizontally in line with the dimension of the diameter or side given in column marked "Side or Diameter," till a number is found in one of the vertical columns under the head "Round" or "Square" and for the stress desired. Divide this number by the helical diameter in inches and the result will be the safe load in pounds. The inverse operation of finding the dimension to carry a given load need not be given in detail.

For values of f, other than those given, a simple interpolation must be performed. Thus if $f = 35{,}000$, the numbers used should be half-way between numbers in corresponding lines and columns under $f = 40{,}000$ and $f = 30{,}000$, respectively.

Also for brass springs, the column under 20,000 may be used if the numbers in that column are considered to be divided by 10. This assumes a value of f for brass of 2,000 per square inch. Similarly for phosphor bronze springs the column under $f = 70{,}000$ may be conveniently used, taking the same precaution of reading the numbers given in the column at one-tenth of their former value.

It may, however, be convenient to point out that the table may be made to apply to elliptical sections if it be remembered that for an ellipse whose major axis is d and minor axis $k\,d$, the safe load is $k^2 W$, where W is the load for a similar spring made of round section of diameter d.

Hence if the load is known and the dimensions d and $k\,d$ sought, choose a convenient number for k, divide the load by k^2 and multiply by D where D = helical diameter, and then treat this new number as if it were the safe load for a round spring, and find d, as described. Thus, suppose 300 pounds are to be carried by a spring of elliptical section whose minor axis is half the major axis, and whose helical diameter is 3 inches. We should proceed thus:

$$k = .5 \text{ and } \frac{300 \times 3}{.5^2} = \frac{300 \times 3}{.25} = 3{,}600.$$

Look for 3,600, or number nearest to it, on the larger side, viz., 3,834.95, marked "round," under the desired value of f, say $f = 40{,}000$, and find under column marked "side or diameter" the dimension $d = 5/8$; hence the spring section would be an ellipse whose major axis is $d = 5/8$, and whose minor axis is $k\,d = .5d = 5\text{-}16$.

W=AXIAL SAFE LOAD. D=HELICAL DIA. f=SHEARING FIBRE STRESS.

Diameter or Side d in Inches.	$W \times D$ (f=20,000).		$W \times D$ (f=30,000).		$W \times D$ (f=40,000).		$W \times D$ (f=50,000).		$W \times D$ (f=60,000).		$W \times D$ (f=70,000).		Diameter or Side d in Inches.
	Round.	Square.	Round.	Square	Round.	Square.	Round.	Square.	Round.	Square.	Round.	Square.	
1-16	1.9174	2.031	2.976	3.046	3.834	4.062	4.793	5.078	5.752	6.093	6.711	7.109	.0625
5-64	3.7450	3.967	5.617	5.950	7.490	7.934	9.362	9.918	11.235	11.901	13.107	13.885	.078125
3-32	6.471	6.855	9.707	10.283	12.942	13.710	16.178	17.138	19.414	20.566	22.650	23.994	.0937
7-64	10.276	10.886	15.414	16.329	20.552	21.772	25.690	27.215	30.829	32.658	35.967	38.111	.109375
1/8	15.339	16.250	23.009	24.375	30.679	32.500	38.349	40.625	46.019	48.750	53.689	56.875	.125
9-64	21.841	23.137	32.761	34.705	43.682	46.274	54.603	57.843	65.523	69.411	76.444	80.980	.140625
5-32	29.960	31.738	44.940	47.607	59.921	63.476	74.901	79.345	89.881	95.214	104.861	111.083	.15625
11-64	39.877	42.243	59.816	63.365	79.755	84.487	99.693	105.609	119.632	126.730	139.571	147.852	.171875
3-16	51.771	54.843	77.657	82.265	103.543	109.687	129.429	137.109	155.315	164.531	171.201	191.952	.1875
13-64	65.823	69.729	98.735	104.593	131.646	139.458	164.558	174.322	197.470	209.187	230.381	244.051	.203125
7-32	82.211	87.089	123.317	130.634	164.423	174.179	205.529	217.724	246.635	261.269	287.741	304.814	.21875
15-64	101.116	107.116	151.675	160.675	202.233	214.233	252.792	267.791	303.350	321.350	353.909	374.90	.234375
1/4	122.718	130.000	184.077	195.000	245.437	260.000	306.796	325.000	368.155	390.000	429.514	455.00	.250
9-32	174.729	195.097	262.094	277.646	349.459	370.195	436.824	462.744	524.189	555.292	611.554	647.841	.28125
5-16	239.684	253.906	359.526	380.859	479.368	507.81	599.211	634.765	719.053	761.718	838.895	888.671	.3125
11-32	319.020	337.949	478.530	506.922	638.040	675.89	797.550	844.873	957.060	1013.84	1116.57	1182.82	.34375
3/8	414.1747	438.749	621.262	658.124	828.349	877.49	1035.43	1096.87	1242.52	1316.24	1449.61	1535.62	.375
13-32	526.586	557.832	789.879	836.748	1053.17	1115.66	1316.46	1394.58	1579.75	1673.49			.40625
7-16	657.694	696.718	986.541	1145.07	1315.38	1393.43	1644.23	1741.79	1973.08	2090.15			.4375
15-32	808.935	856.933	1213.40	1285.40	1617.87	1713.86	2022.33	2142.33	2426.80	2570.80			.46875
1/2	981.747	1040.00	1472.62	1560.00	1963.49	2080.00	2454.36	2600.00	2945.24	3120.00			.500
17-32	1177.569	1247.44	1766.35	1871.16	2355.13	2494.88	2943.92	3118.60					.53125
9-16	1397.839	1480.78	2096.75	2221.17	2795.67	2961.56	3494.59	3701.95					.5625
19-32	1643.995	1741.54	2465.99	2612.31	3287.99	3483.08	4109.98	4353.85					.59375
5/8	1917.475	2031.24	2876.21	3046.87	3834.95	4062.49	4793.68	5078.12					.625
21-32	2219.71	2351.42	3329.57	3527.13	4439.43	4702.85	5549.29	5878.56					.65625
11-16	2552.16	2703.59	3828.24	4055.39	5104.32	5407.18	6380.40	6758.98					.6875
23-32	2916.24	3089.27	4374.36	4633.91	5832.48	6178.55	7290.60	7723.18					.71875
3/4	3313.39	3509.99	4970.09	5264.99	6626.79	7019.99	8283.49	8774.99					.75
25-32	3745.07	3967.28	5617.60	5950.92	7490.14	7934.56	9362.67	9918.20					.78125
13-16	4212.69	4462.65	6319.03	6693.98	8425.38	8925.30	10531.7	11156.6					.8125
27-32	4717.71	4997.63	7076.56	7496.45	9435.42	9995.27	11794.2	12494.09					.84375
7/8	5261.55	5573.74	7892.32	8360.62	10523.1	11147.4	13153.8	13934.3					.875
29-32	5845.66	6192.51	8768.49	9288.77	11691.3	12385.0	14614.16	15481.29					.90625
15-16	6471.48	6855.46	9707.22	10283.2	12942.9	13710.9	16178.7	17138.6					.9375
31-32	7140.44	7564.11	10710.6	11346.1	14280.88	15128.2	17851.1	18910.29					.96875
1	7851.98	8320.00	11780.97	12480.0	15707.9	16640.0	19634.9	20800.00					1.000

TABLE II. STRENGTH OF HELICAL CYLINDRICAL SPRINGS.

The foregoing remarks have up to this point been supposed to apply to cylindrical helical springs, but all that has been said with regard to their strength may with equal correctness be applied to conical springs, provided that the value of the helical diameter D is chosen in a suitable manner—that is, in a conical spring of uniform section, D must be put equal to the largest helical diameter.

Thus in the case of buffer springs which frequently assume the forms shown in Fig. 2, the dimensions of the section at any point may be suitably chosen either by use of the expressions given in Table I or by the use of Table II, provided that the value of D be chosen for the helical diameter of the particular section in contemplation.

(*Concluded next week.*)

Compressing Air to Produce a Dry Atmosphere.

BY FRANK RICHARDS.

Air mechanically compressed may be made serviceable in many ways besides as a transmitter of power, although the transmission of power must apparently continue to be for us its principal function. It is not so in the larger economy of Nature. The atmosphere is the most essential sustainer of life on the earth, and the transmission of power directly by it seems to be a minor and incidental service. The components of the air are the great natural chemical agents, and maintain the life of both animal and vegetable. Air also is Nature's ubiquitous and constant water-carrier. All the waters of all the earth are in turn absorbed, conveyed and redistributed by it.

This ability of air to absorb, convey and precipitate moisture is taken advantage of by us in most of our devices for artificial drying. We know that hot air will carry away moisture, and so we depend on fires to heat the air, and trust to luck for the rest. Much better results may be accomplished by more intelligent action, and a better arranged series of operations. A very practical question embodying this topic has recently been addressed to me personally, and affords a good opportunity for considering one or two of the points involved.

The inquiry is from one of the large chemical concerns of the United States, and deserves to be reproduced verbatim as a good sample of intelligent and perfectly intelligible statement of what it is desired to obtain. The inquiry or statement of the case is as follows:

"For the manufacture of a certain product it is desired to produce and maintain a dry atmosphere in a room 18′ 6″ x 13′ 6″ x 12′. This room is perfectly tight and is to have six operators in it at all times. There will be practically no moisture generated in the room, except that present in the breath and perspiration from the operators. It is proposed to remove the natural moisture from the air before it flows into the room, by first compressing and cooling, then expanding and, if necessary, reheating. We require a liberal supply of warm, dry air with some method of quickly absorbing the moisture coming from the sources indicated. Is this feasible and practical, and, if so, what size air compressor would be necessary to handle sufficient air for the conditions named, to what pressure would it be necessary to compress the air? Would it be necessary to have a condenser in connection with the other apparatus?"

Absolutely dry air is a rather difficult thing to obtain, and of course cannot be secured by the means suggested, but the arrangement may easily be made to produce air which would be comparatively dry, or air in a condition to absorb or abstract moisture with avidity from anything with which it might come in contact. Atmospheric air, or free air, is practically never without moisture, but its capacity for moisture varies greatly with its temperature. Any given volume of air at a given temperature, and which is saturated with moisture will be more than saturated, or will precipitate moisture, if the temperature is lowered. So, also, if the volume is reduced by increasing the pressure, and if the air is then cooled to its original temperature, moisture must be deposited, and if the air is then allowed to re-expand it must be drier than before. The aridity, or comparative dryness of the air, will depend upon the range of its compression and re-expansion. Atmospheric air at 70 degrees Fahr. usually contains from 6 to 8 grains of water to the cubic foot, and will carry about 10 grains. If, then, it is compressed to eight atmospheres and cooled to 70 degrees the volume will be but one-eighth of a cubic foot, and, therefore, all but one-eighth of the moisture, or 1¼ grains, contained in the air will be dropped, and if the air is after this allowed to re-expand, the restored cubic foot of air will then contain only 1¼ grains of moisture.

It is thus only necessary to determine how dry the air must be and to compress the air to the pressure which will be sufficient for the purpose. The air must first be compressed to this predetermined pressure, the means of compression being indifferent. There is not the least objection to compressing it in contact with or in the presence of water, and, in fact, for economy of compression the presence of the water and the constantly low temperature which its presence guarantees is a very desirable condition. While still under its highest pressure the air must be cooled to the lowest conveniently attainable temperature, usually by water, but the water must not now be accessible to the air. The air while at this low temperature and at its highest pressure will be supersaturated, or will have more moisture than it can carry, and to allow it to deposit the surplus of moisture it is only necessary to let it stand for a little time in a receiver, or to have it pass through a pipe or passage of such area of cross section that its flow will be slow. The air after this may at once be allowed to expand to atmospheric pressure, when it will at once become "dry" air, or air with much less than its normal proportion of moisture. After the re-expansion of the air, if it is cooler than is desired it may be heated by any convenient means, but it of course should not have access to moisture until it enters the room where its aridity is desired.

As to the quantity of air required under the conditions given, the dimensions of the room as enumerated do not seem to figure, but merely the presence of the six men who are to be supplied with air for respiration. According to the authorities, 5 cubic feet of free air per minute is enough for a man in winter, and 8 cubic feet in summer. Ten cubic feet of free air per man per minute would be 60 cubic feet for the six men, so that, so far as the men were concerned, an air compressor with a capacity of 100 cubic feet of free air per minute would be a liberal allowance. As the question is asked, we have to say that no condenser is required in connection with the air apparatus.

It is thus a simple and not a costly operation to obtain a dry atmosphere for respiration, and it is somewhat of a wonder that something is not done toward more generally securing it, when, especially during the summer months, we are made so uncomfortable by the atmospheric humidity. Instead of the humidity we may have the air as dry as we choose, if we are only willing to pay for it. Our modern office buildings and our best hotels and apartment houses have now so many arrangements for comfort that it is rather a reproach that some of them have not this also. In some articles which I wrote for these columns a couple of years ago upon "The Uses and Advantages of a Public Supply of Compressed Air," I computed that compressed air at 100 pounds pressure could be furnished at the rate of five cents per thousand cubic feet of free air. Air so supplied would, when expanded, always be "dry" air, and the cost of supplying it would be easily computable. It would of course be a luxury, but, like any other luxury, it should be worth all it cost to those who chose to pay for it. Ten cubic feet per minute would be 600 cubic feet, or three cents' worth, per hour, for what, doubtless, many would be willing to pay a dollar in the times of extreme heat and humidity.

Iron Screws in Stone Walls.

For securing engines and other machinery, also for wall brackets for shafting and for other purposes, it is often desirable to screw bolts into stone walls, and it is difficult to secure a firm hold. The following method is used with success. Of the originator of it we are not informed: A wire of suitable thickness is coiled on the screws so as to follow the threads of the same, and to form a kind of screw nut. The coiling may commence near the head of the bolts and proceed toward the point by laying the wire into the grooves. After arriving at the point of the screw the wire may be wound backward over the helix already wound on, but with a steeper pitch, so as to leave wider interstices between consecutive convolutions of the wire. This wire coil or nut is introduced into the hole formed in the wall for this purpose, it being slightly larger in diameter than the outer layers of wire, after which the surrounding spaces are filled up with plaster of paris, cement or similar binding material in a plastic condition. After the plaster or cement has thoroughly set and hardened, the bolt may be tightened enough to give it a proper bearing and tension.

Trial-Rim Dies.

BY A. H. CLEAVES.

The term "trial-rims," in the optical vocabulary, means a small ring with a handle, for holding an eye-glass lens selected by the optician where glasses are being fitted to the eyes. A large number of them are used in a set, each holding a lens of different curvature, and adapted to slide into a special frame used in trying the sight. I have written and illustrated two methods of making these rings, one with dies and the other with a turret-lathe, as much to illustrate the special dies and tools and methods of working as to say anything about the rings themselves. While those made in the dies are cheaper, as they are more readily made, there is a superior style and finish about those made in the lathe that makes them more fetching and secures for them a better price.

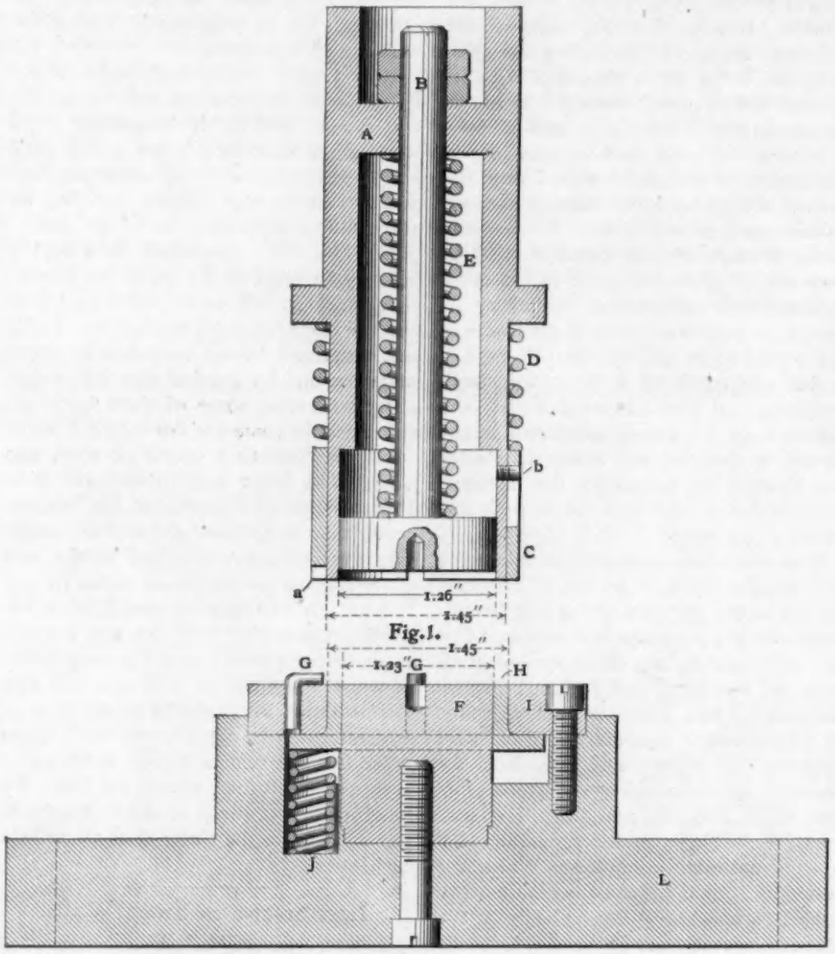


Fig.1.

Fig.2.

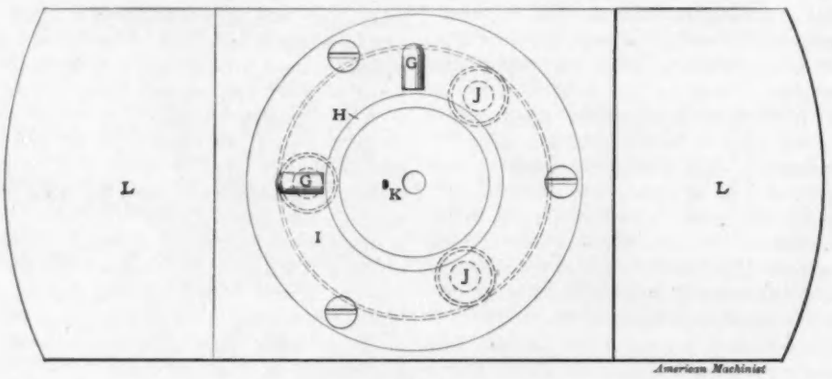


Fig.3.

SECTION AND PLAN OF TRIAL-RIM DIES.

Commencing with the die process, then, in which three sets of dies are used (the metal being fifteen thousandths thick), the illustrations shown in Figs. 1 to 5 will give a good idea of a common style of spring and compound dies used for such work in a common press.

The first pair of dies, Figs. 1, 2 and 3, combine a cutting-out and drawing die. In Fig. 1 *A* is a steel punch with shank on the upper end; and the outside diameter at the lower end, 1.45 inches, enters the lower die, I, Fig. 2, blanking out the stock. Then the inside diameter of the lower part of *A*, 1.26 inches, turns the rim of the blank down over the plunger *F*, Fig. 2, 1.23 inches in diameter.

As the punch *A* passes down over *F*, the shedder H resting on three springs like *J* goes down, too, and lifts the blank from *F* as it comes up. These springs are made of 1-16-inch wire. The plunger *B*, Fig. 1, with spring *E*, makes the upper shedder out of *A*; and the outside shedder *C* strips the stock in the strip from the outside of *A*. The outside shedder *C* has three slots with stop-screws like *b*, and two notches or openings like *a* to pass over the guide-pins *G*, *G*, Figs. 2 and 3. The spring *D* is made of ⅛-inch and *E* of 1-16-inch wire. The die I is solid of course in the base *L*. The center-holes *K* are for locating the dies with a pin. Fig. 4 shows the forming die in which the rim of the trial ring is shown as bulged out by the former. The punch *M* has a shank which is held by a larger socket used for similar small punches instead of making the latter the regular size of larger ones.

The cap made in the first die is placed on *N*, which goes down with the work and bottoms on the base *S*. The surplus stock in the punching spreads out into the curves in the edges of *M* and *O*; the springs *P*, *Q* and *S* returning *N* as the dies separate. The spring *Q* instead of *P* shows a common practice of reinforcing the shedder in die-work. Three springs like S supplement the two in the center.

Coming to Fig. 5, *T* is a cast-iron holder with a steel punch *U* for cutting out the center of the blank. The die *X* has a very thin edge, the upper shedder *V* coming down and preserving the form at *Z*, while the punch *U* continues and cuts out the center of *Z*. The spring *W* is made of ⅛-inch steel.

The Rise and Development of the Science of Mechanics.

The annual address of the retiring president of the Engineers' Club, of Philadelphia, L. Y. Schermerhorn, read January 21, was one of unusual interest and value. We regret that it is entirely too long for reproduction in our columns; but the following extracts will be found to have a certain sequence and connection, and we have no doubt will be welcomed.

"Living under the light and resources of the close of the nineteenth century, it is not easy to place ourselves in the mental attitude of those who lived during the ages in which all the scientific knowledge we now possess was unknown. We have

been so accustomed throughout our lives to deal with cause and effect from the standpoint of the vast knowledge which we have inherited from the near past that it is difficult for us to realize a time when exact knowledge of weight and force was as unreduced as our present knowledge of tastes and smells. Before measures of time were invented, through the use of the hour-glass, the sun-dial, or the clepsydra, the duration of phenomena could be estimated with no greater accuracy than we can now estimate the degrees of hardness with the fingers. Until the thermometer was devised, man's judgment respecting relative amounts of heat was as vague as our present judgment in relation to amounts of sound. Without measures of comparison, more or less exact, only the rudest comparisons, only the most marked differences, could be detected; and as a result laws dependent upon exact measurements could not be surmised, much less determined.

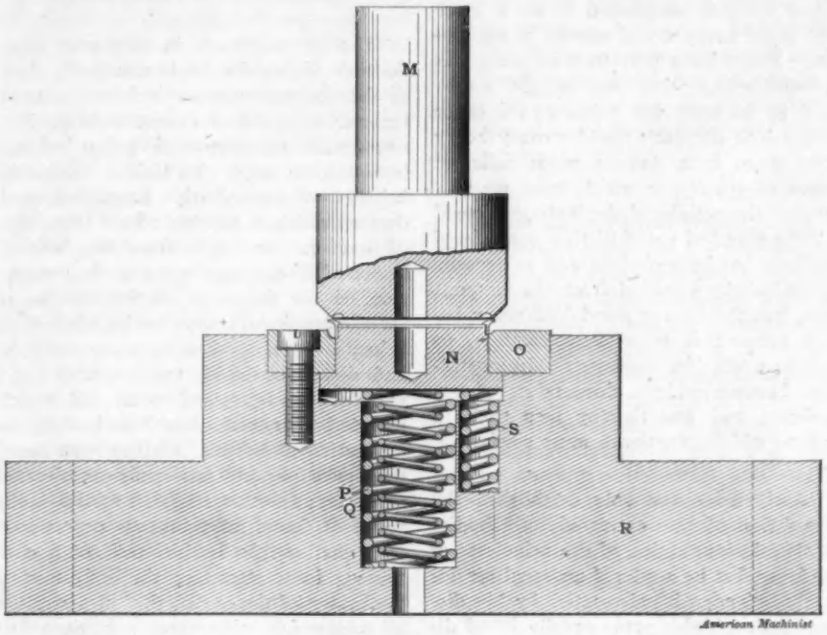


Fig.4.

DIES FOR DRAWING TRIAL-RIMS.

. . . . . .

"Between that epoch in human history when measures of space, time, and weight became fairly established, and the application of these measures to the simplest principle of mechanics, a long interval elapsed.

. . . . . .

"If the colossal structures of ancient Egypt, Assyria, and Greece prove that mechanics then existed as a science, mechanics must have also existed as a science among the builders of the Cyclopean walls of Greece, or at Stonehenge, and elsewhere in the prehistoric world, when such masses were piled on one another as could not have been moved and raised into position without considerable skill. 'The action of every man who raises

the phenomena of nature were only recognized so far as they applied to the rude wants of mankind; or, if made the subject of speculative thought, were reasoned upon without due reference of theory to fact.

. . . . . .

"Mankind began by discovering *a* relation, and ended by discovering *the* relation. The first achievement foretold the kind of phenomenon which would occur: the last foretold not only the kind, but the amount. To determine the amount, measures became necessary and standards of measurements for space, weight, and time were evolved. The reduction to practice of the things by measurement marked one of the great epochs of human advancement, for without it all development would have been impossible and the human race would, therefore, have remained in a condition of savagery. That these standards of measurement were developed during the crude condition of the race is evidenced by the fact that our present measurements of space and weight had their origin in organic substances, such as the arm, hand, finger, and grains of wheat, corn, and barley, while those of time are derived from the periodic recurrence of events of nature.

"Herbert Spencer calls attention to the fact that for those phenomena for which we have found no measures except our sensations, we have no sciences. We have no measures for tastes or smell, and, therefore, no sciences of them. Before the establishment of measures, man's

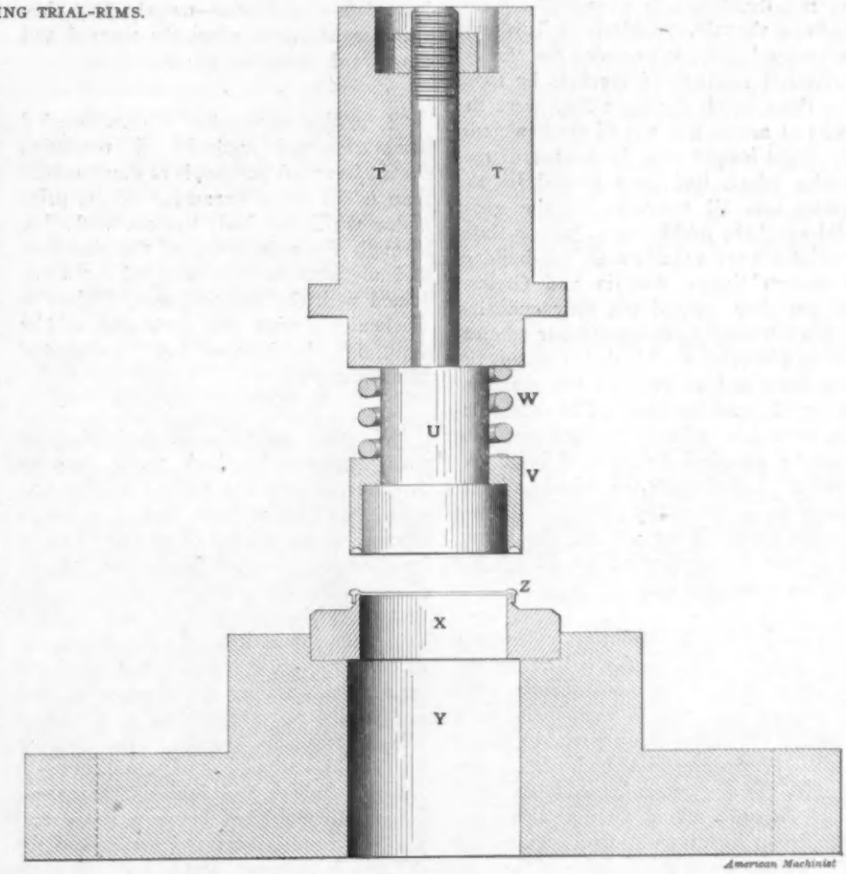


Fig.5.

DIES FOR FORMING TRIAL-RIMS.

and balances weights, or walks along a pole, takes for granted the laws of equilibrium; and even animals constantly avail

themselves of such principles. Are these, then, acquainted with mechanics as a science? Again, if actions which are performed by taking advantage of mechanical principles prove a knowledge of the science of mechanics, they must also be allowed to prove a knowledge of the science of geometry when they act upon geometric properties. But the most familiar actions of men and animals proceed upon geometric truths; even asses know that the two sides of a triangle are greater than the third, but they have not therefore a knowledge of geometry.' And in like manner among men the practical assumption of a principle does not imply a speculative knowledge of it. We see these principles daily exemplified in the work of the laborer with his tools and appliances.

"The wonderful structures of the world from the earliest times down to the close of the middle ages were the work of art and not of science. 'Art is the parent, not the progeny of science.' The admirable cathedrals were built by art, and not by science; but we find in the best work of the architects of all ages that the true idea of mechanical pressure intuitively existed among them more distinctly than among men in general, although it was not developed in a scientific form. We know that the cathedrals of Salisbury, Amiens and Cologne preceded the earliest mechanical treatises of Stevinus by more than three hundred years; they were the works of artists and not of mechanicians. The slight insight into the science of mechanics which had been gained by the Greeks was all unknown to the great builders of the middle ages, just as those principles were unknown to the builders of ancient Egypt, Assyria and Greece; and yet they created not only enduring works, but such as command our admiration and wonder to this day, through the magnitude and difficulty of the constructive problems involved. The constructive inventions of earlier times were devised by practical builders of large experience; and though the science of mechanics could afterward justify, it did not suggest them. They are not the result, much less the application of theory, but only its exemplification.

. . . . . .

"Aristotle and his followers collected a host of facts, but they derived no general law from the facts, and, consequently, when his physics attempted to explain the facts, it had no principles which were of value or avail. Mechanics and hydrostatics are founded to-day upon phenomena with which Aristotle was as familiar as we are. The defect in his philosophy was neither in the depreciation of the value of facts nor in the neglect of their use, but the defect was that though he was in possession of both facts and ideas, the ideas were not distinct and appropriate to the facts.'

. . . . . .

"This was the general condition of the science of mechanics when Archimedes, about one hundred years later, or about 250 B. C., first correctly apprehending weight and force, demonstrated upon correct principles the general proposition that 'equal weights suspended from a lever with equal arms would remain in equilibrium; that a lever with unequal arms was in equilibrium when one weight multiplied by its arm, was equal to the other weight into its arm'; that 'in every heavy body there is a definite point called a *center of gravity*, in which point we may suppose the weight of the body collected.'

"The practical proof of this principle of the lever has been obvious and universally recognized by mankind from the remotest ages, but the human mind had never before reduced it to a demonstration, so that its truth, like a geometric demonstration, became evident independent of experience, and was thereby seen to be a rule to which experience must conform.

. . . . . .

"Archimedes not only established the foundation of the statics of solid bodies by this demonstration of the principles of the lever, but he rendered an equal service to the science of hydrostatics by his discovery that 'fluids press equally in all directions, and from this solved the problem of floating bodies—namely, that they are in equilibrium when the upward and downward pressures are equal.'

. . . . . .

"A proper conception of Archimedes' discoveries and methods of reasoning should have led philosophers much earlier than it did to an expansion of the principles which he had demonstrated; but through the persistence of the doctrines and methods of reasoning of Aristotle, joined with the indistinctness of ideas in mechanics during the dark and middle ages, no development of Archimedes' ideas occurred.

. . . . . .

"We pass over the interval of more than eighteen hundred years between Archimedes and the middle of the sixteenth century without finding a single advance in the science of mechanics or of hydrostatics. In 1586 Simon Stevinus, of Bruges, Flanders, demonstrated for the first time the principle of the inclined plane; the composition of static forces, or, as he expressed it, 'three forces which act upon a point are in equilibrium when they are parallel and proportional to the three sides of any plane triangle.' He correctly applied his principles of equilibrium to cordage, pulleys and funicular polygons; clearly distinguished between stable and unstable equilibrium; and established the difference between static and dynamic problems.

"When the true principle of the inclined plane had been established, the laws of equilibrium for all the mechanical powers were a consequence of this discovery, and that of the principle of the lever already demonstrated by Archimedes; for it was easy to see that the wedge and screw involved only the principle of the inclined plane, and the pulley, wheel and axle that of the lever.

. . . . . .

"The advance made in mechanics from the time of Archimedes to nearly the close of the sixteenth century had been toward the establishment of a science of equilibrium, while the science of motion had not been entered upon. To Galileo the honor belongs of first clearly perceiving and demonstrating a number of the principles of motion. In 1590, from the leaning tower of Pisa, he gave ocular demonstration of the falseness of the dictum of Aristotle, that heavy bodies fall with velocities proportional to their weights, and demolished with unanswerable logic maxims two thousand years old which assigned elemental weight and levity as properties of bodies. Galileo enunciated the principle of uniformly accelerated velocities; demonstrated that motion is the result of force, instantaneous or continuous; that weight is the result of a continuous force attracting the body toward the center of the earth; that in a vacuum all bodies fall with equal velocities; that when another force is impressed upon a body in motion, the additional force is compounded with the force which the body previously had; and established the theory of 'virtual velocities,' which Lagrange, in the next century, applied as the basis of the whole of rational mechanics. Galileo also entered upon the subject of the strength of materials, and published, in 1633, his solution of the problems of the strength of a beam fixed at one end and uniformly loaded; deriving the law that the strength of rectangular beams varied as their breadth and as the square of their depth; he also discovered that hollow tubes offer greater resistance to flexure than solid rods of the same length and quantity of material.

. . . . . .

"Galileo thought quite clearly upon the subject of impact, but encountered difficulties which seemed insurmountable, for he said: 'The force of percussion is infinite, for there is no resistance, however great, which cannot be removed by the force of percussion, however small.' This was upon the assumption that motion was instantaneously arrested; to remove the difficuty, he surmises that the resistance to percussion possibly occupies some portion of time. This suggestion was really a great advance toward the solution of the third law of motion.

. . . . . .

"Galileo had recognized that the air had weight, but he had failed to perceive why water refuses to rise above 33 feet in a closed tube, and could suggest no better solution than the answer of Aristotle, 'that nature abhors a vacuum.' In 1643 Torricelli, a pupil of Galileo, substituted

mercury for water in the experiment; and finding that the suspended column of mercury was shorter than that of water in proportion to its greater specific gravity, he concluded that both columns were sustained by atmospheric pressure, and that the weight of the superimposed column of air was equal to that of the suspended column of water or mercury. He immediately constructed the siphon-barometer, but its practical value was not generally recognized until 1647, when, through Pascal, the measurement of the height of a mountain was made by its use. The importance of this discovery to physics, and to a knowledge of the external world, is obvious.

"Torricelli, in 1643, also demonstrated the theorem that a fluid issues from a small orifice with the same theoretic velocity which it would acquire in falling through a depth equal to the distance between the surface of the fluid and the center of the orifice; and that the velocity of the efflux of fluids from an orifice varies as the square root of the head, allowance being made for friction and the resistance of the air.

"In 1656 Huyghens applied Galileo's discovered property of the isochronism of the pendulum to the regulation of the movements of clocks, producing for the first time the means for exactly measuring time.

. . . . . .

"By the middle of the seventeenth century the philosophic mind had thrown off the bondage of the middle ages, and observation, theory and speculation had awakened an intelligent interest in, and investigation of, the phenomena and laws of the external world. The pupils of Galileo, moving from the point of departure established by their master, had made substantial progress toward the solution of many of the problems of mechanics. Philosophers, from Galileo to Newton, had accepted the conclusion that weight was the result of the attraction of the earth; that this attraction was the cause of bodies falling to the earth, and that it operated on falling bodies as a uniformly accelerating force. They gave to this force the name of gravity; but before the era of Newton attraction of gravitation was not conceived of as a property of all matter, but rather as a positive force emanating from the earth, which attracted bodies toward itself.

. . . . . .

"His discovery was not that there was a force of gravitation, but his discovery was that this force is not confined to the limits of the earth. This discovery immediately opened to the mind of Newton the universe, and enabled him to pass from the particular case to the generalization that attraction of gravitation, instead of being simply terrestrial, was universal; and that any two masses in the universe attract each other with a force which varies according to the inverse squares of the distance.

. . . . . .

"The 'Principia' is the foundation not only of modern astronomy, but of the modern mechanics of solids and mathematical physics; and the wonderful scientific development which has been made of these subjects since the era of Newton is only the sequence of his doctrines of force and motion.

. . . . . .

"In the mathematical consideration of the motion of fluids the theorist has the hypothesis of absolute relative mobility among the particles, combined with the laws of motion. These are conditions too vague and general to lead to satisfactory conclusions, since the assumptions of the mathematician do not probably here represent the real conditions. In the main, the theoretic investigation of motion in fluids is more complex and abstruse than motion in solids; and the solutions of the problems of the former are not so satisfactorily confirmed by the results of observation as are the latter. As a result, the development of the science of hydrodynamics is more incomplete than that of any other division of mechanics.

"In this summary only the salient advances of mechanics are noted, and it is not intended to suggest that the science of mechanics was not indebted for its advancement to other names than those herein mentioned. The history of the science after the sixteenth century carries a noble roll of devotees who, by experiment, observation, and speculation, added here a line and there a precept toward the principles which Newton later built into the modern structure of mechanics.

"In a sense, the science of mechanics which has been here traced is ideal, and without modification would be of small value to the engineer; it is pure or absolute mechanics—'absolute in the sense that its proportions are unqualified. It is concerned with statics and dynamics in their pure forms; deals with forces and motions considered as free from all interferences resulting from friction, resistances of media, and special properties of matter. If it enunciates a law of motion, it recognizes nothing which modifies manifestation of it. If it formulates the properties of the lever, it treats of this, assuming it to be perfectly rigid and without thickness—an impossible lever. Its theory of the screw imagines the screw to be frictionless; and in treating of the wedge, absolute incompressibility is supposed. Thus its truths are never presented in experience, and the inferences to be drawn from them deviate very considerably from the results reached by experiment. Nevertheless, this system of ideal mechanics is indispensable for the guidance of practical or applied mechanics. The engineer has to deal with its propositions as true in full before he proceeds to qualify them by taking into account the natures of the materials he uses.' In other words, through experiment, observation, and experience arbitrary constants must be determined, and introduced into the equations and resulting formulæ of pure mechanics, before such formulæ become a safe guide to the engineer. The determination of these constants is the real work of the modern investigator of the science of mechanics.

"The origin of mechanics was the application of the principles of force and motion to the development of exceedingly simple machines; but in consequence of the vast career into which the principles of motion have been drawn by the splendid problems presented by modern mechanics, the simple origin of the science is almost forgotten. Just as geometry long ago outgrew the demands of land measurement, so the science of mechanics has gone far beyond the narrow limits which first circumscribed its simple machines.

"In these last years of the nineteenth century, mankind is entering upon the grandest era of human progress and development that the world has ever seen; and none doubts that this future development will be almost unlimited, and that its results will be beyond conjecture. Of the factors which will contribute most potently to such an end, the mechanic arts and sciences will be the greatest; and as they have lifted the world from the darkness of superstition, so they will lead it into a light of which we dare not dream. The simple problem of Archimedes has led mankind to the discovery of the lever, the fulcrum, and the force wherewith to move the world."

Letters from Practical Men

Liquid Air.

Editor American Machinist:

Apropos of your remarks on "Liquid Air," March 23, is the process of producing 10 gallons of liquid air by the use of 3 gallons rightfully placed in the category of perpetual motion? You say it is. I think you are mistaken.

Whether or not Mr. Tripler has so produced 10 gallons, or in fact any "surplusage," is a question of fact determinable by evidence, and does not touch the issue.

Your *ipse dixit* that such results "are self-evidently and absurdly impossible," if mistaken may lead many into error, besides tending to discourage research and experiment in a very promising field. Consequently you will not, I think, object to my drawing attention to possibilities of error in your remarks.

The "perpetual motion" proposition involves mechanical self-production of power and motion without aid from an exterior source of energy, with no waste or consumption of fuel. In other words,

power and motion as the result purely of mechanical construction.

If the process under consideration corresponds, is parallel to or in any way comparable to "perpetual motion," then this self-production of power must be present. Does the "surplusage" production of liquid air involve any such self-production of power?

The following quotation from the article in "McClure's Magazine," referred to by you, seems to me to answer these questions in the negative:

"The engine is run with liquid air in the place of water used in steam boilers, *and the ordinary heat of air instead of coal under the boiler.*"

In view of this quotation, which you must have overlooked, it would be as reasonable as your comparison to place in the category with perpetual motion a steam pump which supplies a portion of its discharge to feed its boiler and the "surplusage" to irrigate the garden.

The quotation shows that there is no self-production of power or motion involved. The exterior source of energy is not even obscure. In the solar furnace the fuel consumption and power production are without doubt amply adequate to all the drafts of human enterprise, urged on by the most active of "restive imaginations."

Watt and others put into our hand the key to unlock the stored-up solar energy in coal. Mr. Tripler suggests a way to tap this boundless *costless* energy at its source.

W. H. SMYTH.

Berkeley, Cal.

[The above may be of interest to our readers whose brains are flooded with liquid air at the present time. It will be remembered that Mr. Tripler is reported as having asserted that he has from 3 gallons of liquid air produced 10 gallons, and that he can go on repeating this process indefinitely. As there is not the slightest evidence that he has done or can do this thing it is not worth while to spend much time in discussing it.—Ed.]

A Babbitting Scheme.

Editor American Machinist:

The following scheme for babbitting and squaring, at the same operation, some small bearings on a machine, may interest

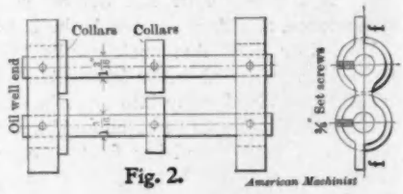


Fig. 2.

FIRST BABBITTING RIG.

the readers of the "American Machinist."

The piece to be babbitted is shown in Fig. 1, which gives the plan and two elevations of part of a machine which has two parallel 1 3-16 inch bearings, side by side,

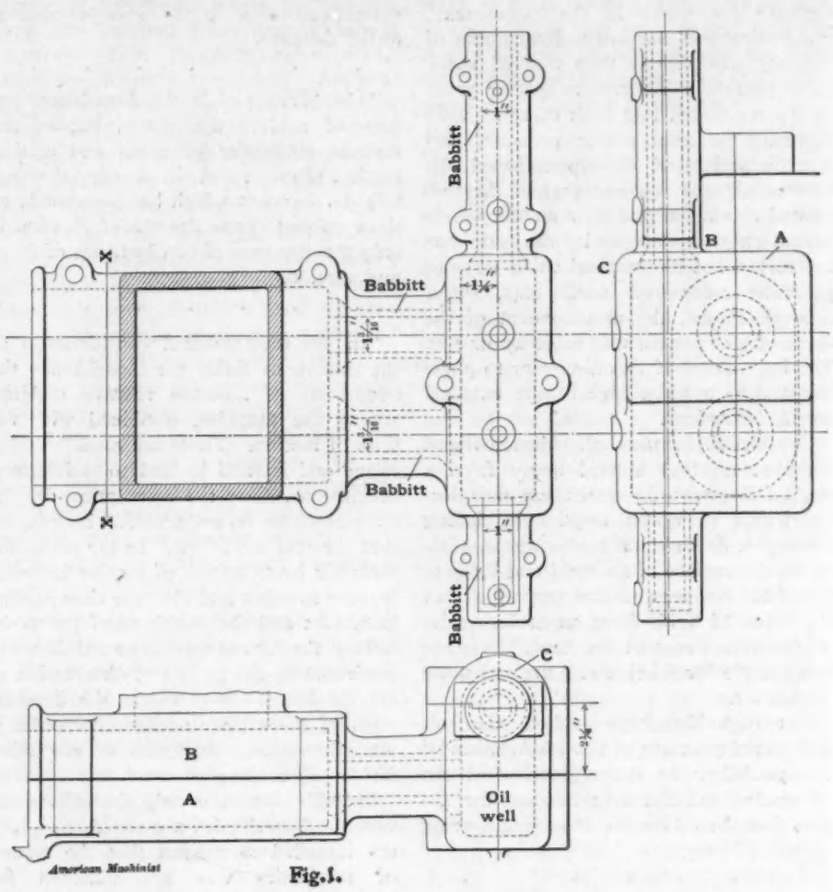


Fig. 1.

THE PIECE TO BE BABBITTED.

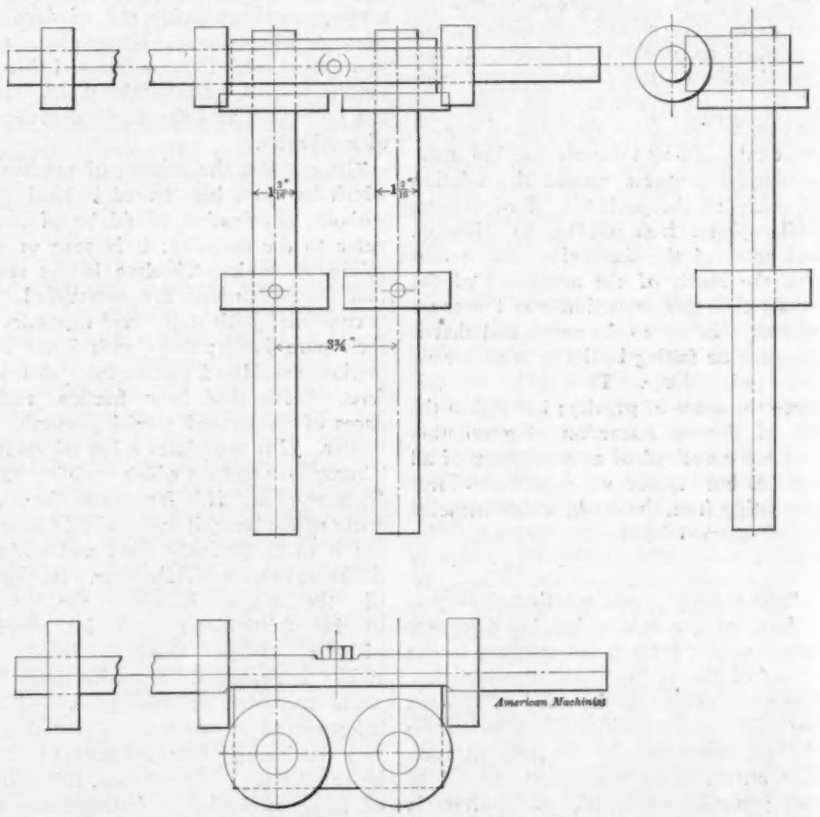


Fig. 3.

FINAL BABBITTING RIG.

and the bearings for a 1-inch shaft, above, and at right angles to them. This shaft carries two worms which engage with worm gears on the ends of the 1 3-16 inch shafts. The gears dip into oil at the bottom of the well and lubricate the worms. The shafts, gear and worms are not shown.

To bore and square the ends of the bearings seemed to be too expensive, and it was decided to babbitt the ends at the same time with the bearings. In Fig. 1, *A* represents part of the base, *B* a feeder cap and *C* the worm cap. All of the joints were planed.

Two pieces, as shown in Fig. 2, were bored to receive the babbitting arbors, which in turn were fitted with collars. One of the pieces was made equal in length to the width of the base at *x x*, and the other to that of the oil well. These were aligned with the base, clamped in position, and the lower halves of the bearings were poured. After the boxes were scraped, the rig shown in Fig. 3 was placed in position, the collars on the 1 3-16 inch arbors bringing the 1-inch shaft the proper distance from the 1 3-16 inch bearings. The feeder cap was bolted on before the 1-inch arbor was put in place. After the collars were up against the bearings and puttied, the upper halves of the 1 3-16 inch and the lower halves of the 1-inch bearings were poured. The 1-inch arbor was then removed, the bearings were scraped, the arbor replaced, cap bolted on and then poured.

The scheme is a success, the whole operation taking but a short time, and resulting in bearings which are true and the proper distances apart. The collars which run against the bearings are made about ¼ inch smaller in diameter than the babbitted recesses. WM. SANGSTER.

Punch and Die Construction.

Editor American Machinist:

I have been much interested in your articles on die construction, but I cannot agree with either Mr. Painter or Mr. Wilcox as to their methods. Mr. Painter's is, I think, much the better of the two. A punch made like that of Mr. Wilcox is expensive to make and to keep in repair. Owing to the keen competition between manufacturers, cost is one of the first considerations in designing new tools, and if the cost of repairs amounts to more than the goods will sell for it leaves the balance on the wrong side. As Mr. Wilcox says, the punches should be short, so as to avoid all springing and the consequent shearing of the tools.

A sketch is here shown of an adjustable punch and die which has saved money for the users on special work, where, under the old method, one hole was punched at a time, and the gage then changed for the next hole, thus necessitating the handling of the same pieces several times. Of course if large quantities were required it would be better to blank and punch at the same time, but on small quantities which can be gotten out on a shear press, it saves not only operations but first cost of tools.

In the sketch, *A* is a shoe in which the dies may be adjusted to suit the holes in piece to be punched. The die *J*, Fig. 2, is a round bushing, and may be packed or raised up in holder *B*, Fig. 3, when necessary to be sharpened. The holder *B* is held in position by set screws *K*, pressing against gib *C*, Fig. 3. The stripper *D* has an elongated slot in the center to allow the adjustment of the punches. The shoe *F*, for holding the punch blocks *L*, is fitted with a gib for adjusting the punches to correspond with dies. Two styles of shells for holding the punches are shown. In *H* the punch plate is reamed from the back, and a taper shell is fitted. This shell is slotted at the large end with a fine saw to enable it to grip the punch when

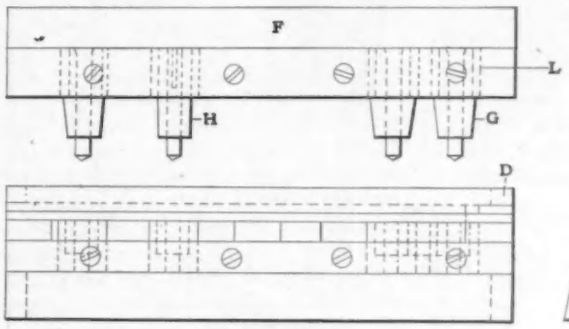


Fig. 1

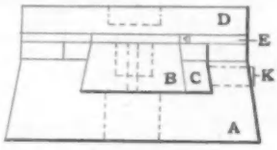


Fig. 3

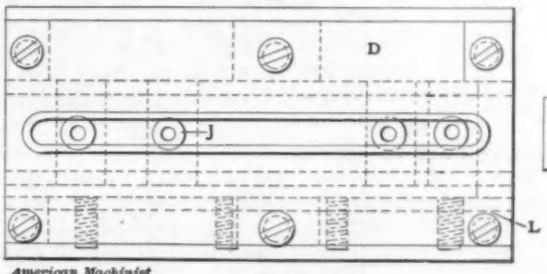


Fig. 2

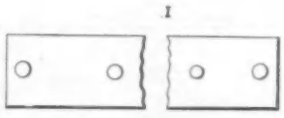


Fig. 4

PUNCH AND DIE FOR A NUMBER OF SMALL HOLES.

driven in place in the punch plate. The punch is a piece of drill rod hardened full length, the pressure of the shell when driven in holding it in place. The objection to this is that repeated driving out of the shell to replace punches gets the hole in punch plate out of alignment with the die. *G*, Fig. 1, shows a punch holder that is turned with a shoulder and riveted into the punch plate. The wire punches are swaged or upset on one end to prevent pulling out, and are hardened all over. It is obvious that you can use this tool for two, four or more holes, as required. To use with less than four holes take out punches.

One great fault that I have found in blanking and punching tools, is that the thickness of the stock is not taken account of in making a set of tools. Most tool makers make the punch a perfect fit in the die for all kinds of stock, and then wonder why the punch does not last longer, or else they blame the steel. The trouble is that the punch fits too close. I have punched a 9-32-inch hole in 5-16 stock by making the die about 1-32 inch larger than the punch. I have seen lots of trouble and expense disappear when die and punch were made to assume their proper relations in regard to the thickness of stock to be blanked. Fig. 4 represents the piece punched in dies shown.

S. R. MUNSON.

New Britain, Conn.

Some Points About Lathes.

Editor American Machinist:

In your issue of February 16, Mr. F. H. Crafts says several things about lathes, in which I think he is wrong.

First, he says the practice of belting from overhead is wrong, because it throws all the strain and wear on the top half of box, throwing the centers out of truth and causing inaccurate work.

If he belts from below, then, when the lathe is taking a light cut or none at all, all wear comes on the lower half of the box, throwing the spindle permanently out of line, or at least making it more difficult to line up again.

If bolted from above, simply tightening screws in the top box will bring the centers in line again. Not counting the wear on spindle itself, which can only be corrected by raising the lower half of the box, the strain from the cut is always against the top of box, except in light work. Why not have the belt pull the same way?

If belted from above, simply tightening slack in the bearings, then the spindle will bob up and down to the extent of the play

in the boxes, unless either a very light or a very heavy cut is being taken.

If a light cut, the belt will hold it down; if a heavy cut, the strain of the cut will hold the spindle against the top of the box. Between the two extremes you can listen and let the lathe tell its own story.

If some of our lathe builders would build a lathe with the following features, I think they would have no trouble in selling it:

Make head spindle at least one-half larger than is the common practice. Have length of spindle bearings about twice the diameter of spindle. Have a better way of fastening down the top cap. I have seen a small lathe (12 inches) with nothing better than two No. 20 machine screws to hold the cap in place.

Tail spindle should be just as large as head spindle. It usually projects farther from its support and has the same strain from the cut as the head spindle. Some means should also be provided for clamping both ends of the tail spindle instead of, as is usual, only one end. Have a substantial way of clamping both head and tail stock to the bed. Leave the back gear behind, where it always has been. Double the width of belt and supply a better way of oiling spindle, then if a good man stands in front of the machine, the chattering ought to take care of itself. J. E. P.

Sacramento, Cal.

A Compound Die.

Editor American Machinist:

In recent years I have had the pleasure of constructing compound dies of several different styles, used principally for producing armature and other electrical supplies; and as a succeeding contribution to Mr. Warman's article, lately published in the "American Machinist," I send herewith sketches of a die, for blanking out a small armature punching, which is somewhat different from his in style and mode of operation.

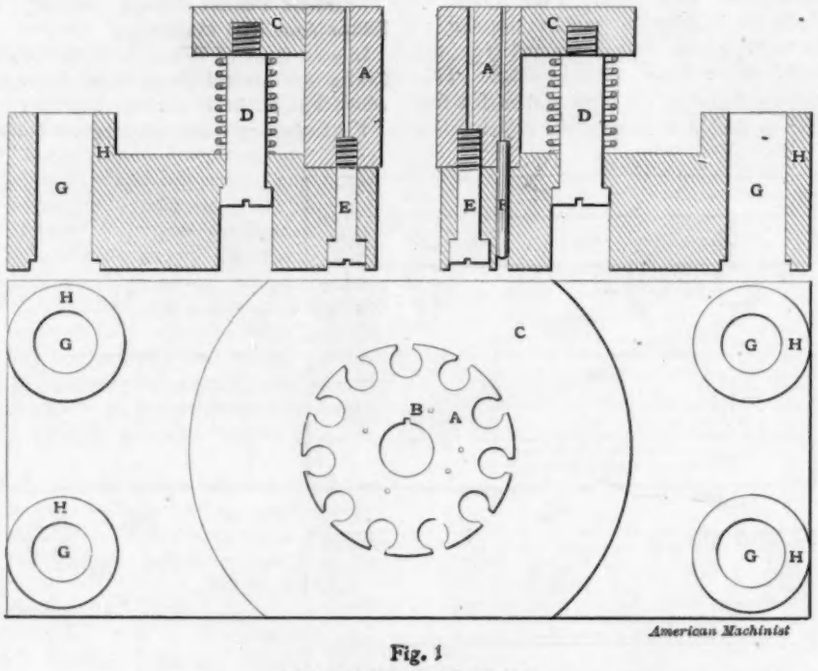


Fig. 1
SECTION AND PLAN OF DIE.

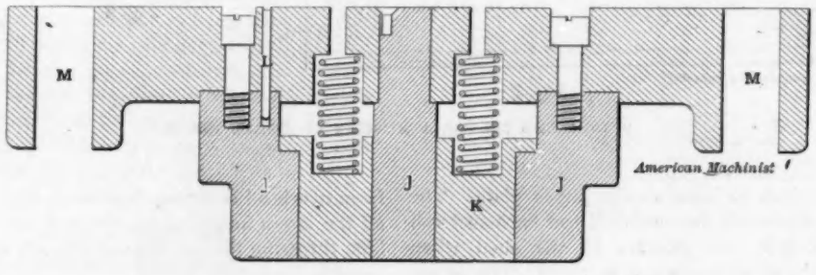


Fig. 2
SECTION OF PUNCH.

Fig. 1 is a side elevation and plan of the die. *A* is the die, which should be bored in the lathe and then be turned on a mandrel, enough being left to grind. A jig with the eleven holes equally spaced, and with projections to fit into the hole in the die, can now be used to drill and ream the holes for the notches at the periphery. Now place on centers in the milling machine and cut through to the holes the desired width. File radius *B* on side of center hole, harden and draw to light straw color, and grind to size.

C is the stripper, retained in its proper position by six screws *D*, and actuated upward by springs. *E E* are four screws to hold die in cast-iron holder. *F* is a dowel pin to prevent the die from turning. G are four 1-inch holes to sub-press die, and are bossed to give bearing and support to the pins.

Figs. 2 and 3 are side view and plan of punch. When constructing these tools place the outside cutting punch *I*, Fig. 2, in the lathe and turn and bore almost to size. Dove-tail the slots at an angle of about 10 degrees on a side; taper them two degrees, making them large at top or cutting edge of punch. Harden and grind to allow the die to enter, also grind on outside to fit recess in holder.

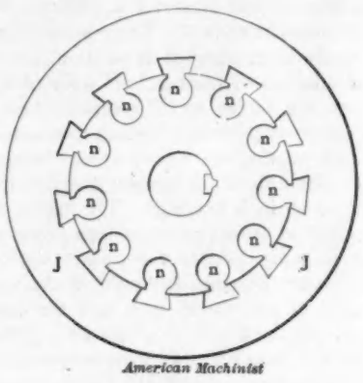


Fig. 3
PLAN OF PUNCH.

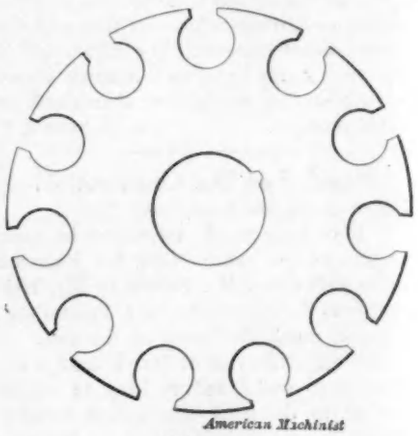


Fig. 4
FULL SIZE AND SHAPE OF PIECE PUNCHED.

The center punch *J* is turned, hardened and ground, being previously dove-tailed to receive piece for cutting notch in blank. *K* is a stripper, supported by outside punch and operated by springs. *L* is a dowel pin to keep the punch from turning in the holder when in operation. *M M* are holes for sub-press pins.

Fig. 3, *N* are parts of punch that are to

be fitted after the ring is ground, being driven into the dove-tail slots about 1-64 inch below surface. Enter the die and mark out the shape; number and remove; work down to line; replace and prove work. After finishing harden and drive the pieces into their proper place. As the slots taper, a tight fit will of course be obtained every time.

The next move is to fasten the die and punches into their respective holders with strippers removed. Enter them; level and support with parallels; strap together. Now drill and ream the four 1-inch holes for the sub-press pins. The pins should be made of tool steel, hardened and ground to a perfect running fit in the punch holder, and left a little large for about 2 inches from the head. Drive up from the bottom into the die holder. Assemble your punch and die, and if your work is properly done they are set once and for all.

When it is desired to re-sharpen your die, carefully drive out pins and replace when ready for use. The cutting punches and outside of the die should be ground straight; the inside should have a taper of five-thousandths to one inch. Fig. 4 is exact size of sheet-iron blank produced by this die, though we have sizes much larger produced by dies made on this plan.

DIE MAKER.

Lynn, Mass.

Amateurs' Lathes.

Editor American Machinist:

If Mr. F. H. Jackson will look up a lathe made somewhere in the United States that uses a bicycle motion and also carefully ground and fitted bearings he will have no trouble with hard running machines.

My 13-inch lathe, 6-foot bed, drills a hole 1 inch in diameter through 4 inches of cast iron in about half an hour. I do not suffer from the cold when the job is finished, but I cannot find a one-legged lathe motion that will begin to do the work.

I know you will not care to advertise the makers of my lathe, but I will send their address to anyone, for as an amateur I have tried several lathes, and the bicycle motion is the only one for me.

I agree with Mr. Jackson about the "overhead." Why cannot some good maker build one to attach to lathes already in the hands of amateurs?

J. H. TEN-EYCK BURR.

Cazenovia, N. Y.

Re-boring a Large Pulley.

Editor American Machinist:

Most small repair shops (large ones also) sometimes get a job that is too large to handle in the lathe. As most repair shops do not have a boring mill they must do it the best and generally the quickest way they can, and more so if it is a repair job, as the customer is always in a hurry. In the columns of the "American Machinist" I have read descriptions of how to bore large wheels in the lathe by changing the head stock; but I do not think it a good plan to change the head-stock. I will give a description of how I bored a large pulley by hand. It may interest some.

The pulley was a very heavy one, 4½ feet in diameter by 14-inch face. The bore was 2½ inches and it was to be bored to 3 inches. It was the main driving pulley in a grist mill. The line shaft had broken off in the pulley, and they wanted to put in a piece of 3-inch shaft. I used the old piece of line shaft and made a boring bar of it. The piece was about 4 feet long. I cut a slot ¾ inch wide and 1½ inches long, and keyed in a cutter 3 inches long, to cut on both ends. The slot was cut about 8 inches from the end. The cutter was keyed in, and the bar was stood upright in a strong vise, the pulley lifted up and slipped on the shaft onto the cutter, the pulley being turned around by hand, and the weight of the pulley being the feed. We had to be careful in starting the cut in the rough hub, and the key-seat was not very nice to start a tool in; but with a little patience we got it started, and it cut very fast. When about two-thirds of the way through, a bushing of some description was required in the lower side of the hub already bored to act as a guide. I used three pieces of thin hard-wood, which answered the purpose very well. The time in making the bar, boring, and recutting the key-seat was five hours. Only one hand in the shop was employed on the pulley, while another was turning the new piece of shafting. After the wheel was set up it ran as true as possible to have it.

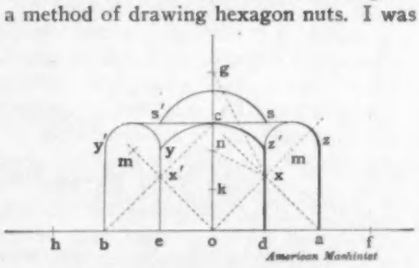
H. C. DAVENPORT.

[It might have made the operation a little more comfortable if the old key-seat had been filled with babbitt, hammered in to make it tight, before beginning the boring.—Ed.]

Drawing Hexagon Nuts.

Editor American Machinist:

In the issue of March 16 of the "American Machinist" Mr. Morris Fulton gives a method of drawing hexagon nuts. I was



DRAWING HEXAGON NUTS.

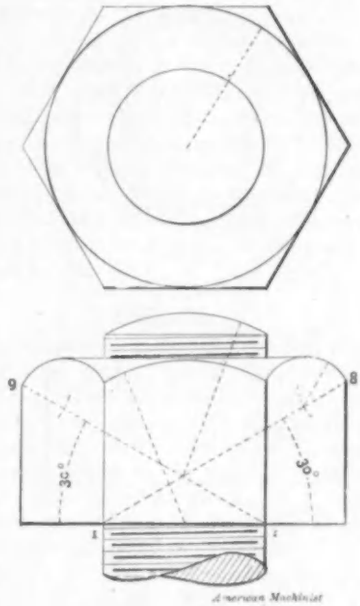
interested in his method, and supposing that he would like to know how other people do practically the same thing, I give my method below. I do not claim it to be superior to his, except that it does not require the use of a diagram.

I start where the center and base lines of the nut cross, and with o as a center I strike points a, c and b, making $o\,a = o\,c = o\,b =$ diameter of bolt; then from the points a, o and b I draw the light 45-degree lines each way, as shown, and from the points x and x', where these lines cross each other, drop perpendiculars to the base line, thus giving me the points d and e. Again, with o as a center I strike points f, g and h, making $o\,f = o\,g = o\,h = a\,e$, and again with the 45-degree triangle from f and h I find m and m'. I now draw the top line of the nut, and parallel to it, through m and m', strike the point n. Now with g as a center and radius $= g\,x$ strike the point k, and with radii $c\,k$, $c\,n$ and $n\,x$, and centers at k, m, m' and n, I draw the arcs $z\,y$, $z\,z'$, $y\,y'$ and $s\,s'$, respectively. The verticals now being drawn, the nut is completed. I hope that the above method will be of interest to Mr. Fulton and other readers of the "American Machinist."

JIB.

Editor American Machinist:

I enclose a sketch showing what seems to me to be a better and easier method of drawing hexagon nuts than that shown by Morris Fulton in your issue of March 16,



DRAWING HEXAGON NUTS.

especially where these nuts are only drawn to show their position and to make the balance of the drawing look complete; for, unless to be used in some particular place, the standard bolts or nuts of the factory will be used, and no detail is required to show the exact size and shape. This sketch shows the thickness greater than is generally used in actual work, as does the method shown by the other article.

In the method shown here the rule or scale is used for but one measurement, and all other points are obtained from that with the dividers or 30-degree triangle. As in almost every case the

center of the bolt or screw is a known point, we take one-half the diameter from the scale and space twice this distance each side of the center. With the dividers open to the diameter of the bolt, and with the center of the base for a center, gives the arc of the center face. From the lower corners of this face draw lines 1—8 and 2—9, at an angle of 30 degrees, crossing each other in the lower half of the face, and from the point of their crossing as a center and a radius equal to the diameter gives the arc for the top of the bolt, while the distance from the base line to this crossing point gives the radius for the arcs of the side faces, the centers being on the angular lines. The angular line also gives the hight of the extreme sides, and the hight of these sides forms the length for a radius to draw the inscribed circle in drawing a plan of the nut. To show threads draw lines by eye and mark with the number of threads to the inch, unless making a show drawing where time is not so much account as looks.

DRAFTSMAN No. 2.

Editor American Machinist:

I would like to supplement Mr. Fulton's excellent article of March 16 with a description of another method of laying out hexagonal nuts and bolt heads, which possesses the advantage of training the draftsman's eye and hand to draw in his work with almost no measurements.

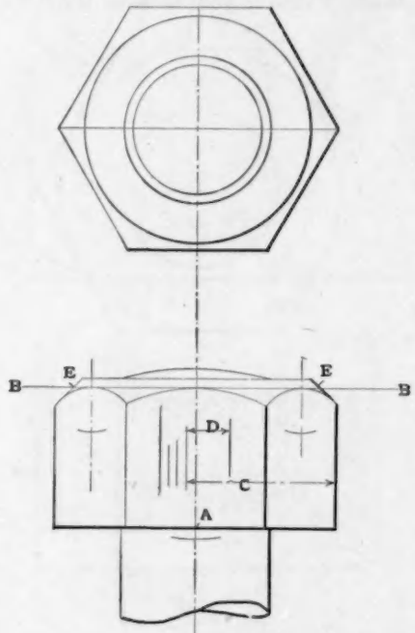


Fig. 1

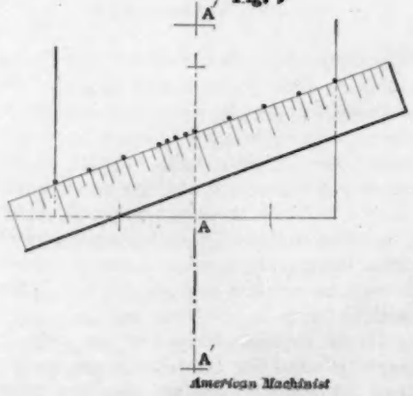


Fig. 2

DRAWING HEXAGON NUTS.

First, from the center lines lay out accurately the bolt diameter, the nut hight and $A\,A'$, which should be equal to the "across hex" measure, which should be taken from a table, and is, approximately, twice the bolt diameter. Divide the "across hex" measure into eight parts, and one of these into four small spaces, as in Fig. 2. Draw $B\,B$ one small space below the top. Set the bow pencil to a radius D (= 5 small spaces) and draw the side circles, and C (= 17 small spaces) for the center circle. Draw the bolt end with A' for a center. With the 45-degree triangle draw $E\,E$ tangent to the side circles. In the plan the sides should be drawn with the 60-degree triangle tangent to the "across flats" circle rather than to the "across hex" measurement.

GEO. F. SUMMERS.

Schenectady, N. Y.

Turning Crank Shafts.

Editor American Machinist:

I have read with interest your many articles on turning crank shafts, and especially the one in March 2 issue, by John Randol. As I have had considerable experience in turning cranks of this kind, my experience might be of interest to some.

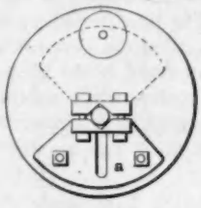


Fig. 2

Fig. 3

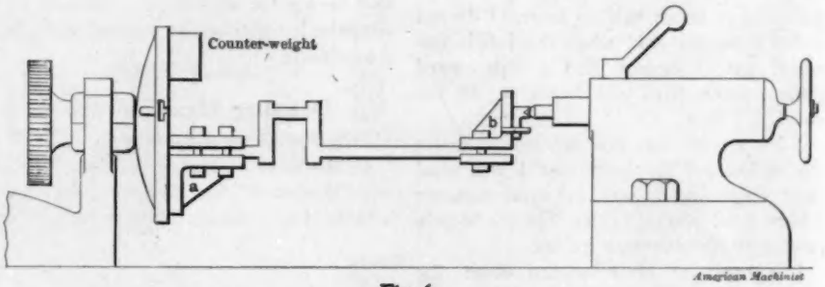


Fig. 1

TURNING CRANK SHAFTS.

The first cranks I had to do with were to run in crank and fly-wheel steam pumps and ammonia pumps, with a sliding box on the wrist working in a yoke cross-head; no connecting rod being used. We turned them as shown in the cut of Mr. Randol, March 2, with the exception of the eccentric steady rest. The difficulty we had was that the center of wrist and shaft would not lie in the same plane, consequently the yoke would wabble; a very slight error would be magnified in the yoke, while if the same crank were used in an engine, the error would not be detected. We then adopted the use of a flange bored to fit the shaft snug and faced true, with set screws to bind the shaft. We then bolted this flange on the face-plate of lathe, out of center equal to the throw of crank to be turned, put in the crank, tightened set screws, put a steady-dog on other end, as shown by Mr. Randol, and were ready to turn. When done this way, you will have a shaft that will stand all the tests for truth. The wrist and shaft centers will be parallel and in the same plane. But as this method required a flange for each size, there being some twelve to fifteen sizes, I adopted the method shown in the sketches.

Set castings, plane V-grooves in them the first thing, then clamp castings *a* and *b* on a straight mandrel and face them both at the same time. By so doing you can place a straight-edge on the faces and know that both are faced square with the V-grooves. Make the whole thing very strong and it will hold all the lathe will pull. The center for tailstock end is movable always, so put the center in and tighten afterwards. Casting *a* can be reversed, as shown by dotted lines Fig. 2, when necessary. This rig has the advantage of taking a number of sizes, any throw, holding securely without marking the shaft, and being dead true.

HUGH HILL.

Bolts and Nuts in Scotland.

Regarding the opening for American-made bolts and nuts in Scotland, the United States consul at Edinburgh writes:

"Inquiry has been made at this consulate by a wholesale agent, handling largely bolts and nuts and like articles, for the name and address of a company or

firm in the United States manufacturing bolts (round and square, countersunk heads) and cold-cut nuts. He wishes to obtain this particular combination for the Scottish market. This business man informs me that the American manufacturers are now pushing the Germans very hard for the trade in bolts and nuts in the United Kingdom. The importation of these articles from the United States began about eighteen months ago. For many years the German manufacturers had little or no foreign competition in these islands for machine-made bolts and nuts, and the British manufacturers could only hold the market for the common square-head bolts. In 1897, bolts and nuts began to come from the United States, and the trade has been growing. Of late, it has been increasing rapidly. In this dealer's opinion, should there be no reduction of prices by the German and no increase of prices by the American manufacturers, the latter will soon get the bulk of the trade. The process of gaining the market would be easier, he says, if some of the American bolt and nut manufacturers did not persist in sending the goods in packages of 100 and of 50, although they know that it is the custom in the retail trade here to buy bolts and nuts by the gross and half gross."

Affairs in Russia.

It is reported that the Trans-Siberian railway that is being constructed by Russia is very poorly built and will prove of little use for carrying on railway operations with modern rolling stock and by modern methods. It is announced also that at this juncture, when Russia is in such great need of foreign capital and enterprise for her internal improvement, the Ministry of Finance issues the decree that after July 1, 1899, Russian workmen in manufactories and workshops belonging to foreigners shall be under the supervision of Russian overseers.

This is most likely the result of foolish attempts to interfere with religious customs and observances, but it seems likely to seriously interfere with the industrial development of the empire.

Incorporation of the Bickford Drill Company.

Announcement is made of the incorporation for $100,000 of the Bickford Drill & Tool Company, Cincinnati, Ohio. The business conducted by this firm was established in 1874 by Mr. Henry Bickford, who, it will be remembered, was one of the early pioneers in the manufacture of the modern type of drill press. This interest in 1887 passed into the hands of Mr. Charles Hoefinghoff, whose death, in November last, has already been mentioned in these columns.

The officers of the new company are: H. C. Hoefinghoff, president and general manager; L. G. Keck, secretary and treasurer, and H. M. Norris, engineer and works manager. Mr. Hoefinghoff has recently become identified with the company, while Mr. Keck is one of the original partners of the old firm. Mr. Norris' term of service dates from the middle of May, 1897, since which time he has been devoting his attention to improvements in design and methods of manufacture. It is the purpose of the new management to concentrate its efforts on the manufacture of drilling machinery, which, for some years past, has been made an exclusive specialty.

Good Workmen at Watervliet.

A press despatch dated Washington, April 1, has been sent us by a reader, and in this despatch Colonel Mordecai, who it will be remembered, was transferred from the Springfield armory to Watervliet because he could not get along with the employees, is quoted as having reported to the Ordnance Bureau at Washington to the effect that it is found impossible to secure and retain competent machinists at Watervliet. He says that "Though some 200 workmen were employed in about two months, not over six were found capable of being graded as first-class machinists. Thus was shown the impossibility of procuring in an emergency from this vicinity, where there is little or no supply to draw upon, workmen of the quality required for gun construction."

Our correspondent says that the wages offered at that time by Mordecai were $2.80, and that the reason so few good men were secured was that good men could do better elsewhere. He says it requires a "pull" to get the maximum rate of $3.04, and as the pull is not easy to acquire good men prefer to go where no pull is needed. He concludes as follows: "If Colonel Mordecai wants good men let him offer as good wages as private capital pays for men of that type and he will find that more than 3 per cent. of the applicants will be good workmen."

Not Killed by Liquid Air.

An announcement is made in the daily papers that a man has been killed in Chicago by liquid air. As this may convey a wrong impression, it is proper to call attention to the facts. Archibald Campbell, superintendent of the factory of the Healy Ice Machine Company, of Chicago, had been for years experimenting with apparatus for producing liquid air, and is said to have been successful long before Mr. Tripler's results were made known to the public. In November of last year Mr. Campbell was injured by the blowing out of a valve of an air compressor, the valve striking him in the forehead and disabling him for a time. He was soon able to resume and continue his work, but two weeks before his death the wound began again to trouble him, and he finally succumbed to its effects.

Personal.

Our esteemed contributor, R. H. Palmer, has lately become foreman of the foundry of the Howard Iron Works, Buffalo, N. Y.

Mr. A. A. Ambler, formerly of Springfield, Ohio, and more recently of Chicago, is now superintendent of the Western Manufacturing Company, of Kansas City, Missouri.

We learn that although Mr. Lucian Sharpe, of Providence, is in much better health than formerly, he is still unable to devote much time to business, and he contemplates another trip to Europe.

William B. Murdock, late with the Pratt & Whitney Company, sailed with his family on the 19th from Boston to take up his residence in Birmingham, England, as foreign representative of the Jones & Lamson Machine Company.

Mr. Gardner C. Sims is holding the position of superintending engineer of the United States army transport service, his location being in the Army Building Whitehall street, New York City. He "will be responsible for the care and maintenance of all steam and mechanical appliances of transports; * * * select for nomination to the general superintendent all employees of the engine department, and be responsible for their discipline and efficiency, and for the economical and satisfactory working of the machinery and steam and electrical appliances." This looks like a comprehensive job, but lest he should have too much unoccupied time he is also required to "perform such other duties as may be directed by the general superintendent."

Obituary.

George Peacock, founder of the Peacock Iron Works, Selma, Ala., died in that city March 26, seventy-six years old. Mr. Peacock was born in England and learned the molder's trade there. In 1848 he was working at his trade in Albany, N. Y., and, constantly advancing, he was located successively in Troy, Cleveland, Louisville and Natchez, Miss. In the latter place he was managing a foundry when the civil war broke out, and he served the Confederate Government in foundry management throughout the war, later establishing the works which bear his name. He was one of the pioneers of the iron business in Alabama, especially in the manufacture of pipe.

Captain William B. Skidmore, superintending engineer of the Brooklyn & New York Ferry Company, died April 14; seventy-seven years old. He was apprenticed as an engineer when fifteen years old, then had a position on a steamer of the old Black Ball Line; was for eleven years a chief engineer of a Pacific mail steamship, and then took charge of the company's shops at Yokohama, Japan. He held his position with the ferry company twenty-five years, retiring last August.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

(47) M. M. B., Camden, N. J., sends a sketch of the multiple washer thrust bearing used for the thrust bearing of worm gears, and asks what the advantages of the construction are and how the friction is calculated. A.—The advantages of the arrangement grow out of the fact that several slipping surfaces are provided. The one which has the least friction at any moment becomes the acting bearing, but should it get dry or develop a tendency to cut, the movement is at once transferred to another surface and the first one gets a rest. A feature which you may not have noticed, or which may not have been present in the bearing examined, consists of making the holes larger—by, say, 1-16 inch—than the shaft. This introduces a compound motion and reduces the tendency to streak the surfaces. The bearing is much more satisfactory than a plain step, but we are unable to give any definite figures from which to calculate the friction. It would not be materially less than that of a plain step, provided both were in equally good condition.

(48) L. V. B., Wheeling, W. Va., asks: (1) Having an engine with cylinder diameter of 7 inches and stroke of 10 inches, at what speed must I run it and what must be the boiler pressure to develop 10 or 12 horse-power, also at what point should it cut off? A.—An indefinite number of combinations of speed, pressure and cut-off would give the required power. For each pound of mean effective pressure in the cylinder, and for each revolution per minute, the engine will develop .00194 horse-power. Multiply this constant by the proposed pressure and the proposed speed, and you will obtain the horse-power. Thus if the pressure is to be 50 pounds and the speed 100 revolutions per minute, the power will be $.00194 \times 50 \times 100 = 9.7$. Such an engine would probably have a plain slide valve and the cut-off would not be earlier than at five-eighths stroke. (2) What would be the amount of water necessary to make the steam for each movement of the piston in above mentioned cylinder? A.—An engine of the pattern described would consume not less than 50 pounds of water per 1 horse-power. This figure multiplied by the horse-power and divided by the number of strokes per hour, would give, approximately, the consumption of steam per stroke.

(49) A. D. T., New Albany, Ind., (1) sends dimensions of a plain slide valve which he desires to balance and asks how the balancing area is to be calculated. A.—We presume you intend to balance on the principle of the Richardson valve, in which case there is no known rule for the area within the balancing strips. The varying pressure in the parts at different times—full boiler pressure immediately after cut-off, and atmospheric pressure during release, together with the varying pressure during compression, and other factors—probably make such a rule impossible. Over balancing is to be avoided. The areas within the strips of the Richardson valve, as used on locomotives, were, we believe, obtained by experiment, and equal 55 to 60 per cent. of the entire area of the valve. This percentage might not, however, be suitable to valves having a different lap and different exhaust cavity areas. (2) In a round cast iron box, having a revolving paddle and filled with oil, would the resistance to revolution of the paddle be increased by corrugating the inside of the box? A.—Yes. Approved designs for brakes of this class consist of a series of disks, quite close together, and attached alternately to shaft and box. Water and not oil is used in the box, and as this soon becomes hot it is necessary to provide a circulation. Your third question is not sufficiently clear for us to answer.

Technical Publications.

"The A B C Telegraphic Code." By W. Clausen-Thue. 480 5½x8½-inch pages. Fourth edition. The American Code Publishing Company. Price $5.

The A B C code is probably the most widely used cipher code in existence, and it gives us pleasure to notice this new edition of it. The price will be seen to be materially reduced from the old figure.

"The Slide Rule." By C. N. Pickworth. Eighty-eight 5x7½-inch pages, with nine illustrations; pamphlet cover. D. Van Nostrand Company. Price two shillings.

This is the fifth and enlarged edition of a book which has already been noticed in these columns. It gives a clear discussion of the theory of the instrument without an undue amount of mathematics, and will be found a satisfactory manual for self-instruction. Numerous conversion tables are given, as well as detailed instructions for setting the rule for the combined use of the different scales—a class of work which has been called "slide-rule gymnastics," and of which we do not altogether approve.

"A Treatise on Photographic Optics." By R. S. Cole. 325 5x7¼-inch pages, with 103 illustrations. D. Van Nostrand Company. Price $2.50.

This book is a treatise on photographic lenses, together with so much of the theory of light as is necessary for the main purpose. The elementary theory of lenses, together with their defects and the methods of correcting the defects, are discussed at length, and with the aid of considerable mathematical work, though probably no more than is necessary for the proper discussion of the subject. Lens testing, exposure, stops, shutters, depth of focus, etc., receive due attention.

"Steam Boiler Practice in Its Relation to Fuels and Their Combustion." By W. B. Snow. 297 6x9-inch pages, with 24 illustrations. John Wiley & Sons. Price $3.00.

This book is not a treatise on boiler design or construction. It deals rather with the various methods and systems of operating and the various arrangements and their adaptation to different fuels and other conditions. It thus covers a field but spar-

(*Continued on page 41.*)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant: see p. 16.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer. Mach. T. Co., Meriden, Ct.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

For Sale—Drawings, patterns, etc., for modern gas engine. Box 247. AMER. MACH.

Light and fine mach'y to order: models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking" price $1, post paid. J. L. Lucas, Prov., R. I. Sent for index sheet.

For Sale—The whole or one-half interest in a well-established machine shop. Box 245, AMERICAN MACHINIST.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., New York.

For Sale, Cheap—Second-hand gage lathe, double end, 22-ft. bed, 26 and 38-in. swing. Box 253, AMERICAN MACHINIST.

Bound volumes of "American Machinist" for 1893 and 1894, cloth, good condition, $3 each; one of 1888, morocco, $4. "Volumes," care AMERICAN MACHINIST.

Best workmanship; reasonable charges; watch, clock and other light machinery; send for samples of punch and die work. Waltham Machine Works, Waltham, Mass.

Wanted—Manufactured machine-tool appliance: West preferred: $35,000 ultimately required: improved staple article; big demand; good profit. Box 249. AMER. MACH.

For Sale—Machine shop in Cincinnati, fully equipped for manufacturing 12 to 18-inch engine lathes, and employing 20 hands. Walter Schlotman, 600 East Third st., Cincinnati, Ohio.

Factory to rent at Elizabethport, N. J.: size, 150x50; 60 windows, all improvements, engine, etc.; on line R. R.; strong, fine building; 12 city lots enclosed; rent very low. Address Capt. Coote, Elizabeth, N. J.

Institutions retiring from business having machine tools, brass or wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisement under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

An experienced designer of sheet metal working machinery, etc., is open for a position; West preferred. Box 248, AM. MACH.

Wanted—Management or responsible connection with Boston office of firm or corporation; scientific education, character, energy and wide acquaintance. G. M. Warren, West Newton, Mass.

Situation wanted as superintendent or

master mechanic, by an American, 35 years old; 10 years' practical experience as same; hustler and cost-cutter; best references. Box 252, AMERICAN MACHINIST.

Young man, technical education, 4 years' varied experience, knowledge of several European languages, desires to change; position as draftsman, assistant master mechanic, or to represent; references. Box 244, AM. MACH.

Mechanical engineer and designer desires position; graduate, with 16 years' shop and office experience, Marine-Corliss and high-speed engines, compressors, hoisting engines, mining machinery; best references. Address Box 251, AMERICAN MACHINIST.

Help Wanted.

Wanted—An expert for estimating and laying out gear work. Address "Gear," A. MACH.

Wanted—All-round gear-cutting man for Boston shop; also man for office; give full particulars. Address "Gear," AMER. MACH.

Wanted—For out of town, first-class draftsman; state age, experience, references and salary expected. Box 241, AMER. MACHINIST.

Wanted—Assistant draftsman, experienced on machine tools; state qualifications, reference and salary expected. The Bickford Drill & Tool Co., Cincinnati, Ohio.

Wanted—First-class foreman for shop building heavy general machinery; one familiar with piece work; state experience. Address Box 250, AMERICAN MACHINIST.

A leading manufacturer of air compressors desires a first-class, experienced salesman. Address, with full details of previous experience and connection, Box 243, AMERICAN MACHINIST.

Wanted—A first-class lathe hand, familiar with printing-press cylinder work; also general machinists. Address, stating age and qualifications, Taunton Locomotive Mfg. Co., Taunton, Mass.

Machinists wanted by engine builder located in the neighborhood of New York; skilled men only, to work on all-night gang; write concerning ability and pay expected. Address Box 230, AMERICAN MACHINIST.

Wanted—Foreman for machine shop building machine tools, hydraulic and general machinery; give full particulars as to experience as foreman, age and salary expected. Address Box 236, AMERICAN MACHINIST.

Draftsman wanted by a manufacturing establishment located about one hour from New York City; applicant must be familiar with steam engine designing; state experience and pay required. Address Box 229, AMER. MACH.

Wanted—A bright, intelligent man, not over 35 years of age, to take charge of a machine shop in a large textile manufactory; must be a fair draftsman and have knowledge of modern machine-shop methods. Box 246, AMERICAN MACHINIST.

Wanted—General foreman to take charge of shops manufacturing steam engines and special machinery, employing 300 to 400 men; must be a good manager of men and thoroughly posted in machine-shop practice. Answer, giving experience, references and wages expected, Box 242, AMERICAN MACHINIST.

Wanted—Foreman, one experienced in the line of stamped light hardware, and thoroughly capable to institute modern shop practice; must have had some years' experience as foreman, be able to systematize work and handle men to the very best advantage; give references and state wages expected. Address Williamsport Staple Co., Williamsport, Pa.

Wanted—Foreman for machine shop, with good experience in engines and general machinery and the handling of men; give full particulars, age, experience, reference and the least wages considered; we want a man between the age of 30 and 40, who can design method of short way of doing work to reduce cost; permanent employment given to satisfactory man; shop located in Pennsylvania, employing 40 to 60 men. Address Box 240, AMERICAN MACHINIST.

Wanted—A thoroughly experienced and reliable foreman for machine shop (employing 30 to 50 men) connected with a large woodworking establishment; principal work, patented specialties, general factory repairs, etc.; man with executive ability and capable of reducing costs to the minimum; must be ingenious, progressive and a good manager; give references, experience and salary expected. Address Lock Box 1602, Philadelphia, Pa.

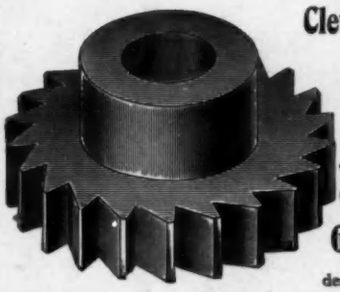
IMMEDIATE DELIVERY.

Latest Improved Upright Drills.

7—20″ Wheel and Lever Drills.
3—20″ Wheel and Lever, Back Geared.
1—21″ Wheel and Lever, Power Feed.
4—24″ B. G. P. F. A. S.
3—28″ B. G. P. F. A. S.
1—40″ B. G. P. F. A. S.

The Lodge & Shipley Machine Tool Co.,

CINCINNATI, OHIO.



Cleveland Gear Works

W. R. SAWYER, Lessee.
86 Seneca St., Cleveland, Ohio.

GEARS of all descriptions.

A THINKING MAN

realizes the benefits of an education. You can obtain an education which will qualify you for a better position and higher pay if you will devote some of your spare time at home to study at a cost so low that you will not feel the outlay. Courses by mail in

Mechanical, Steam and Electrical Engineering, Mechanical Drawing and Machine Design. Best Text Books and Drawing Plates Free.

Seven years of experience in teaching by correspondence. Write for our illustrated Circular T, sample pages of text books, drawing plate and booklet of letters from students all over the world.

The United Correspondence Schools,

154, 156, 158 Fifth Ave., New York.

THE PEOPLE WHO BOUGHT THE 8000 or 9000 Frisbie Friction Clutches

that are now in use didn't buy them because they were pretty. They bought them because they wanted clutches that would do the right thing at the right time, without any fuss or bother, and they got just what they were after. We'd like to send you a long list of these people, with some further interesting details about the Frisbie Friction Clutch.

The Eastern Machinery Co., New Haven, Conn., U.S.A.

(*Continued from page 40.*)

ingly covered by treatises on boiler construction, and one in which information has been heretofore scattered through numerous papers before engineering societies and articles in the technical press. Among the subjects treated are the admission of air above the fire, the prevention of smoke, economizers, mechanical stokers, the rate of combustion and its effect on economy, chimney and mechanical draft, the latter subject including the closed ash pit, the closed fire room, and the induced systems. Many tables of results of tests are given, and the book will be found useful to students and practitioners alike.

"Engineer's Handy Book." By Stephen Roper. 831 4½x6½-inch pages, with 325 illustrations. Fifteenth edition. Revised and enlarged by E. R. Keller and C. W. Pike. Published by David McKay, Philadelphia. Price $3.50.

Mr. Roper's numerous books have had a sale out of all proportion to their value. They are full of undigested matter, not to say positive misinformation, and there has been to us an element of the pathetic in the manner in which those who could ill afford the expense have bought such books in the effort to supply their educational deficiencies. The sale which they have had has, however, given a commercial value to their titles, and the title of the old book is about all of it that appears in the new one before us. The revisers have, in fact, "revised" the old book into the waste basket, where it belongs, and around the old title have written what is practically a new book. We do not have the old book before us, but outside of purely descriptive matter we doubt if fifty pages of it can be found in the new one. The result is a book containing nothing which cannot be found elsewhere, but which, nevertheless, will serve a good purpose in the hands of those for whom it is intended, though this is not to be understood as indicating that it is now what it might be or ought to be. The new edition contains additional parts on gas and gasoline engines and on electricity, the latter of which especially is well written, and contains perhaps more information of the kind needed by those in charge of electrical machinery than can be found elsewhere in the same bulk in print.

One of the younger alumni of Wesleyan College has just furnished funds for the erection of a building where liquid air may be produced and used for experiment and investigation.

A correspondent in Adelaide, Australia, suggests that it would be a good idea if advertisers in our paper would state the prices of machinists' special tools, because he finds that it takes him a very great while after receipt of the paper to write here and get quotations and then afterward get the tools. In some cases there would probably be no objection to stating

prices, and where there is no such objection it would certainly be a convenience and an advantage in trading with people in distant parts of the world.

The list of candidates to be voted upon for admission to the different grades of membership of the American Society of Mechanical Engineers at the spring meeting is an unusually large one. The list is as follows: For members, 39; for associate members, 5; for promotion to full membership, 6; for promotion to associate membership, 1; for junior members, 34; total, 85.

Manufacturers.

The Port Gibson (Miss.) Oil Works contemplate the erection of an oil mill at Leland, Miss.

Lobdell Car Wheel Company, Wilmington, Del., is to erect a 44x132-foot addition to its plant.

The iron work of the factory of the Bay City (Mich.) Sugar Company is now being erected.

A wood-turning factory will be established at Norristown by J. B. Brusher, of Philadelphia, Pa.

The Duplan Silk Mill Company, of New York, contemplates the erection of a new mill at Hazleton, Pa.

The Neptune Laundry Company, Philadelphia, contemplates making an addition to the plant and putting in new machinery.

William M. Bunding and James H. Morris have purchased a tract of three acres at Pottstown, Pa., as a site for a manufactory.

It is reported that the shops of the Pullman Palace Car Company, in Wilmington, Del., will shortly be enlarged and improved.

J. E. Henry & Son's new mill, built to replace the one burned last December, is nearly finished and will be equipped with modern machinery.

The Carr-Adams Company will begin work soon on the construction of their manufactory at Seventh and Cherry streets, Des Moines, Ia.

The Miami Cycle and Manufacturing Company, of Middleton, O., has decided to build a factory somewhere in Ontario for the manufacture of their wheel.

The Cawley, Clark Company is about to erect a two-story frame factory at Newark, N. J. It will be 70x200 feet in dimensions; estimated cost, $9,000.

The F. W. Wolf Company, architects, of Chicago, have prepared the plans for a $400,000 beet sugar factory which Hauser, Hayton & Owen, of Grand Rapids, Mich., will build at Kalamazoo, Mich.

Mr. H. McD. Robertson of Wilmington, N. C., is mentioned in connection with a despatch reporting that Northern capitalists have arranged to erect a $100,000 cotton factory in Fayetteville, N. C.

The Cooleemee cotton mills are to be built at Jerusalem, N. C., by B. Frank Mebane, of Greensboro, and others. Plans are now being prepared for a building to accommodate 800 looms and 25,000 spindles.

Private plans are being prepared by John B. Riehl & Co. for an addition to their present plant at 7014 Woodland avenue, Philadelphia, Pa. A one-story and basement brick and iron building, 25 feet square, will be added.

A meeting of the directors of the Amer-

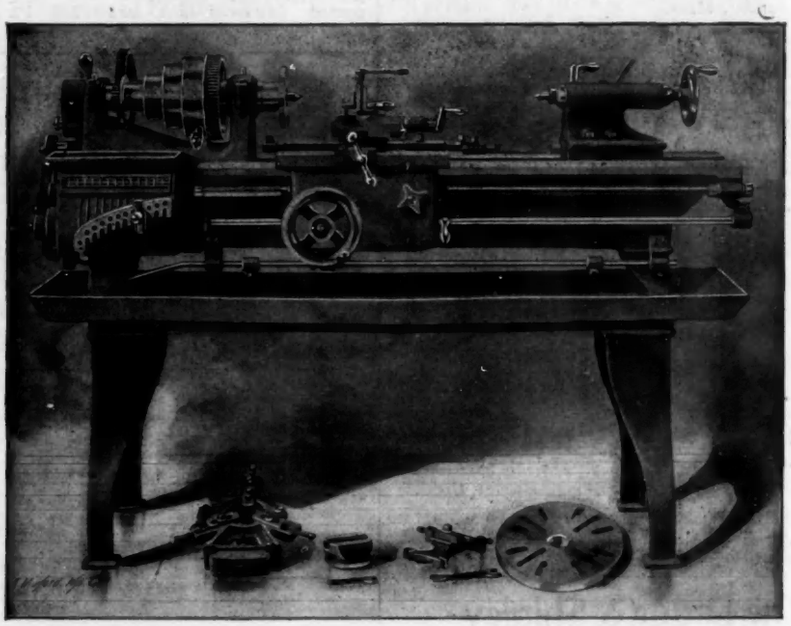
(*Continued on page* 43.)

The Hendey Machine Co.

TORRINGTON, CONN.

This Company is the sole owner of Letters Patents Nos. 470,591, 519,294 and 549,006, granted to W. P. Norton for Improvements in Engine Lathes.

We take this method of notifying the public that we have already commenced suit against infringers of these patents, and that should it be found necessary to the protection of our rights, additional suits will be brought against manufacturers, vendors and users of infringing lathes.



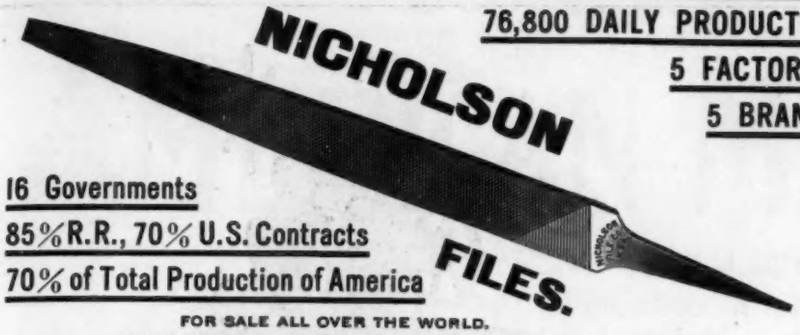
The merits of these improvements have been widely recognized and have been wantonly copied. We shall take vigorous steps to protect our own.

The Hendey Machine Co.,

TORRINGTON, CONN.

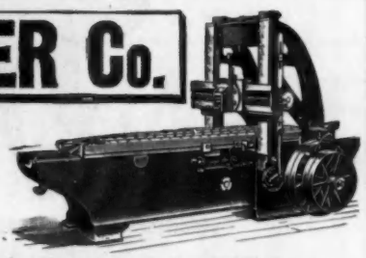
AGENTS FOR THE PACIFIC COAST:
Pacific Tool and Supply Co., San Francisco, Cal. J. W. Cregar, Philadelphia Bourse Exhibition.

EUROPEAN AGENTS:
Schuchardt & Schutte, Berlin, Vienna, Brussels. Chas. Churchill & Co., London and Birmingham, England
Adolph Janssens, Paris, France.



76,800 DAILY PRODUCTION
5 FACTORIES
5 BRANDS
16 Governments
85% R.R., 70% U.S. Contracts
70% of Total Production of America
FOR SALE ALL OVER THE WORLD.
NICHOLSON FILE CO., Providence, R. I., U. S. A.

POWELL PLANER Co.
WORCESTER, MASS.



U. Baird Machinery Co., 125 Water St., Pittsburgh, Pa.
Robinson & Cary Co., St. Paul, Minn.
W. R. Colcord Mchy Co., 502 North 2d St., St. Louis, Mo.
Parke & Lacy Co., Fremont St., San Francisco, Cal.
The Fairbanks Co., 705 Arch St., Philadelphia, Pa.

COMPARE WEIGHTS
WHEN YOU ARE TOLD THAT JENKINS' '96 IS MORE EXPENSIVE THAN OTHER PACKINGS.
Average weight 1/8 inch "Jenkins '96," 11 lbs. to the square yard.
" " 1/8 " Red Packing, 14 " " " "
At 50c. per pound "JENKINS' 96" is not only very much cheaper, but the best joint packing manufactured.
JENKINS BROS. NEW YORK, BOSTON, PHILADELPHIA, CHICAGO.

STEAM BOILER PRACTICE IN ITS RELATION TO FUELS AND THEIR COMBUSTION
AND THE ECONOMIC RESULTS OBTAINED WITH VARIOUS METHODS AND DEVICES.
By WALTER B. SNOW, S.B., Member American Society of Mechanical Engineers. First Edition. First thousand. x + 297 pages; 24 figures. 8vo. Cloth, $3.00. *Order through your bookseller; or copies will be forwarded, postpaid, by the publishers, on the receipt of the retail price.*
JOHN WILEY & SONS, 53 East 10th Street, New York City.

GRIND UP YOUR EMERY WHEELS.
A substance that will cut emery will do your grinding and polishing faster than you are doing it now. It will do more work. It will do faster work. It will save you money.
CARBORUNDUM
will cut emery with ease. Carborundum is the hardest substance in the world excepting the diamond. It is made up in forms and grades to suit the requirements of the grinder and polisher of metal, glass, granite, pearl, wood, leather, carbon, rubber, ruby, sapphire and porcelain.
THE CARBORUNDUM CO., NIAGARA FALLS, N.Y.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.
J. M. ALLEN, President.
WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary.
L. B. BRAINERD, Treasurer.
L. F. MIDDLEBROOK, Assistant Secretary.

TANKS of WOOD and STEEL
For Factories, Railroads, Parks, Small Towns, Private Grounds, etc. Also STEEL TOWERS.
W. E. CALDWELL CO., Louisville, Ky.
Send for Illustrated Catalog. 255 E. Main St.

The CROSS OIL FILTER

actually reduces oil bills 50% or more. Sent on approval. Capacities 3 to 150 gals. per day. Used in 23 countries. Testimonials from the leading firms in every field of industry.
THE BURT MFG. CO.
AKRON, OHIO, U.S.A.
Business Established 9 Years.
Largest Manufacturers of Oil Filters in the World.

(*Continued from page 42.*)

ican Waltham Manufacturing Company, Waltham, Mass., was held recently, and a vote was passed to purchase additional machinery amounting to $14,000, to be placed in the factory.

A Pittsburgh firm has been awarded the contract for a new foundry building, 150 by 250 feet in dimensions, for Shenango Machine Works, at Sharon, Pa., at a cost of $50,000. About 150 men will be given employment.

A. Winters & Son, of Allegheny, were awarded the contract, amounting to $14,000, for excavating for the foundation piers, trenching and sewering of the new plant of the Pressed Steel Car Company, at McKees Rocks, Pa.

The Western Electrical Instrument Company, of Newark, N. J., have broken ground for a new shop at Waverly, N. J., which shop will represent the latest practice. It will be 250 feet square, of brick, and will have a saw-tooth roof.

Messrs. A. & P. Roberts, of the Pencoyd Iron Works, have purchased property near Norristown, Pa., and will in the near future erect a plant for the manufacture of billets of steel. They will install all necessary power apparatus and machinery.

It is now well understood that the Parker Mill Company, Fall River, Mass., will build a 25,000-spindle cotton factory on Rhode Island, perhaps at Warren or Barrington. It was reported last week that a site of 13 acres had been purchased at Warren.

The Guernsey Electric Company, of Cambridge, Ohio, has been incorporated with $5,000 capital stock to manufacture and sell electric light and power. William C. Benbow, W. P. Devore, S. C. Hayt, H. H. Meeks and O. Wharton are the incorporators.

The Frasse Company, established in 1806, will move about May 1 from their present address, 19 Warren street, New York, to 38 Cortlandt street. Increase of business demands the removal to be able to accommodate their line of machinery and tools.

The Philadelphia Railway Track Equipment Company, recently incorporated and capitalized at $500,000, with Conrad F. Clothier, Jr.; Thomas A. Burrows and George H. Johnson as incorporators, will erect a large brick and iron plant in Philadelphia in the near future.

A wall-paper manufacturing house in New York has purchased the old J. Howard Lewis paper mills, in Nether Providence, near Swarthmore, Pa., and has contracted for additions to the plant, one of which is a building, 50 by 500 feet, in which the printing of the designs will be done.

Messrs. Greenleaf & Loring, the Auburn (Me.) contractors, are to build the new mill of the Madison paper plant and reconstruct the old mill. This plant is now a part of the Great Northern Paper Company. Messrs. Greenleaf & Loring have begun work on the job. It is a $125,000 job.

A factory will be built at Ellwood City, Pa., this spring by the Dallenbaugh Gas Engine Company. Work will be begun upon the foundations within a short time, and the company expects to have its plant in operation before the end of June. Two buildings, 90x22 feet, are to be erected at first.

The directors of the E. N. Welch Company, Bristol, Conn., have about decided as to their plans for the construction of a new department. New buildings will be erected on land north of the river, owned by the company, and the shop will be of wood, three stories high, 200 feet long and 40 feet wide.

Contractors William Steele & Sons, Philadelphia, Pa., have plans for over $20,000 worth of work for Drueding Bros., at Lawrence and Master streets. The work will include the

construction of fifth and sixth floors on the present mill and the erection of a new six-story addition, about 36x90 feet, with an L-shaped wing, about 18x90 feet.

Preliminary plans are being prepared for the erection of a brick and iron plant for the manufacture of tanks and vats. This will be owned and built at Colwyn, Pa., by George Woolford, Esq., whose present works are at 2238-2240 North Ninth street, Philadelphia, Pa. The main building will be 100 by 150 feet, three stories high.

The contract for the building of the addition to the paper mill at the plant of the Hollingsworth & Whitney Company, Waterville, Me., has been let to the firm of Purinton & Co. The contract calls for the erection of a heater room 80x100 feet, a finishing room 70x120 feet, and an addition of 100 feet more to the machine room which was built two years ago. The buildings will all be of brick, and will be of the same general design as those which are now standing on the works of the company and will cost not far from $50,000.

Nordyke & Marmon, Indianapolis, Ind., machinists and engine builders, are constructing additions to their present factory that will add more than 75,000 square feet of floor space. There is to be one addition two stories high, 243 by 60 feet in dimensions, another two stories high, 75 by 50 feet, and another of one story, 252 by 60 feet. An extra story is also to be added to one of the present buildings, which is 175 by 48 feet in dimensions. Two of these buildings are about completed and work on the third is beginning. In addition to these, before long the firm will erect a two-story brick storage building 80 by 100 feet to hold castings and metal stock. All of the buildings are to be substantially built of brick, with iron roofs and woodwork of slow-burning construction.

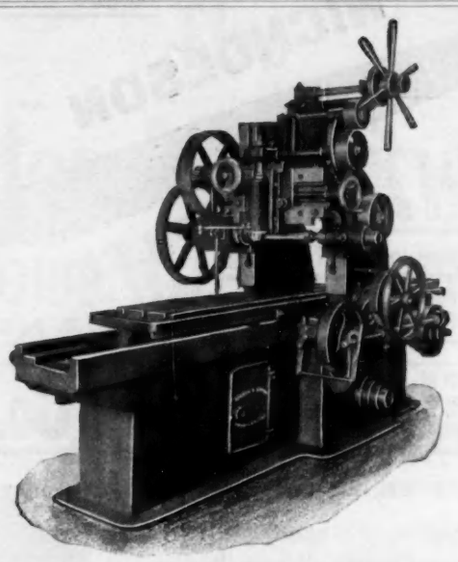
New Catalogs.

We have received from the Ingersoll-Sergeant Drill Company, New York, copy of Booklet 169, which contains a small engraving of each of the various types of air compressors made by the company referred to. The booklet is 3¼x4¾ inches.

We have received from the Chandler & Taylor Company, Indianapolis, Ind., catalog of tandem compound engines. The construction and method of operation of these engines are gone into quite minutely. Illustrations of the engines and valve connections are included. The catalog is standard size, 6x9 inches.

The Campbell Gas Engine Company, Limited, Halifax, England, has sent us catalog illustrating and describing the Campbell "Oil" Engine, which is made only by the company referred to. The principal features and advantages are enumerated, and numerous illustrations are scattered through the catalog showing these engines as built for various services, including the driving of electric-light machinery, propulsion of ships, etc. There is also described a number of ram pumps made by the same concern. The catalog is 9½x12 inches.

The Meadville Vise Company, of Meadville, Pa., has issued a catalog illustrating and describing Barrett's cylinder boring machines. These machines shown vary in size from those capable of taking in cylinder flanges 26x36 inches long to those which will take in cylinder flanges 64x60 inches long; but we understand machines are made any size to suit customers. The machines are adapted to bore and face engine cylinders, boring guides, stuffing boxes—in fact, all places where a true and smooth bore and face are required. The catalog contains a list of users of the machines, also a few commendatory letters. The catalog is 8x11 inches.



Horizontal Spindle Milling Machine, with Vertical Spindle.

A STRONG, SUBSTANTIAL TOOL, EMBODYING ALL MOST RECENT IMPROVEMENTS.

TABLE 14 IN. WIDE, 8 FT. LONG.

EUROPEAN AGENTS:
Selig, Sonnenthal & Co., London.
Garvin Machine Co., Berlin.
Adphe. Janssens, Paris.

Beaman & Smith,

PROVIDENCE, R. I., U. S. A.

Makers of the above, and other regular and special Machine Tools.

Adjustable Bench Levels.

With ground and graduated vials,—accurate and very sensitive.

These Levels are so constructed that they can be accurately adjusted, and when so adjusted are not liable to get out of truth, the vials being set in tubes having solid ends which are firmly clamped to the base. The tubes are nickel plated, the bases japanned or nickel plated. The outer tube may be turned so as to protect the glass when not in use. For sizes and prices see our catalog.

CATALOG OF FINE MECHANICAL TOOLS, MILLING, GEAR AND OTHER CUTTERS SENT ON REQUEST.

THE L.S. STARRETT Co., Box 59, ATHOL, MASS., U. S. A.

NEW YORK OFFICE: 126 LIBERTY STREET.

FOREIGN AGENTS:

LONDON—Tools, Chas Churchill & Co., Ltd., 15 Leonard Street, Finsbury, E. C.
Cutters, Chas. Neat & Co., 112 Queen Victoria Street, E. C.
BRUSSELS—Schuchardt & Schütte, 17 Rue de Fossé aux Loups.
BERLIN—Schuchardt & Schütte. 59 Spandauer Strasse.
SYDNEY—Edge & Edge, 250 Pitt Street.
YOKOHAMA—F. W. Horne, Box 174.
VIENNA—Schuchardt & Schütte, VII, Bez. Breitegasse, 17.
BUDAPEST—Székely & Káldor, Erzsebet-Körut 9-11.
LA CHAUX DE FONDS—W. Hummel Fils, 30 Rue Peopold Robert.